

THE
FIELD
ENGINEER.

Translated from the FRENCH of
M. le Chevalier DE CLAIRAC,
BY
Captain CHARLES VALLANCEY.

To which are added,

REMARKS
ON
Marshal SAXE's new System of
FORTIFICATION,
Proposed in his REVERIES, or Memoirs on the
ART of WAR.

Fas est et ab Hoste doceri.

DUBLIN:
Printed for JOHN SMITH, at the Philosophers Heads
on the Blind-Quay. MDCCCLVIII.



X X

TO HIS GRACE
JOHN Duke of BEDFORD,
Lord Lieutenant General and General
Governor of IRELAND; Major
General of His Majesty's Forces, &c.

MR. LORD,

THIS Treatise, which I have the Honour to lay before your GRACE, hath been the Employment of my leisure Hours, at *Kinsale-Fort*, when the Weather would not permit me to carry on the Works there.

The Original, being universally esteemed as the most compleat of its kind, I thought a Translation of it, might be of service to those Gentlemen of the Army, who for want of Knowledge of the *French* Language, or seeing the Operations of a Campaign, may be unacquainted with this useful Branch of the Art Military.

If therefore this Performance, imperfect as it may be, should happily meet with your GRACE's Approbation, and be thought in any manner conducive to the Instruction of my Brother Officers, it will abundantly recompence the Labours of

My LORD,

Your GRACE'S,

Most Obedient and

Most humble Servant

CHARLES VALLANCEY.

A



THE FABLE
OF THE BUMBLE-BEE.
BY JOHN DYER.
LONDON: Printed for J. Dyer, at the Sign of the
Bumble-bee, near the Tower of London. 1662.

The original printing of this fable, I understand,
was done complete in one volume, in folio, of 16 pages.
This edition is of it, which is now scarce, and scarce to
be had, except in Antwerp, where it is printed
continually, and sold by the booksellers there.
Knowledge of the Author, and his place of birth,
the qualifications of a Captain, and his rank, are
described in this history, which may be seen
in the first page of the title-page, and in the
title-page itself, which is written in Latin.
It may be noted, that this book was written
at a time when the Author was in such
dangerous apprehension of his life, that he
had no opportunity to have it published
elsewhere, than in his native country, where
he could not hope to find a publisher.

BY JOHN DYER.

THE FABLE
OF THE BUMBLE-BEE.

BY JOHN DYER.

WITH A HISTORY OF THE AUTHOR.

CHARLES MELLANCOLH.

THE P R E F A C E.

THE Knowledge necessary for an Engineer, is of two different Kinds, one speculative, demonstrable, and consequently invariable, serving as general Principles, and making part of what is directly called Science; the other more practical, and arbitrary, immediately comprehends the different Objects of his Profession.

We have a sufficient Number of Treatises on elementary and practical Geometry, and on the Principles of Algebra; there are also good ones on Mechanicks, and Hydraulicks.

If those Sciences, that is, those Parts of the Mathematicks necessary to be known, previous to an Examination, were all that is necessary for the Theory, it is plain that all the Assistance requisite, is to be had; but, to imagine it thus confined, is not to know all the Extent it may, or ought to have.

Independent of this speculative, and preliminary Theory, there is a practical Part, which from Ideas, carefully examined, shews us the most eligible Means of attaining the End proposed, and procures us the second part of Knowledge necessary.

Altho' these two Parts are equally necessary, we are as much at a loss for the Means of acquiring one, as we are abundantly provided for the other.

The reason of this difference is evident: To treat of speculative Knowledge, it is sufficient to understand Geometry, but much experience is necessary to give satisfactory Instructions on the practical Part;

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and tho' the Number of Engineers, capable of doing this, was equal to that of other learned Men, their Employment, which confines them to the Frontier Towns, and finds them almost constant Work, allows them little time to range their Ideas in order, much less the Means of giving them to the Publick.

Yet the speculative Theory, being only a means by which we may arrive, by the shortest and surest Road, to the practical, and of all Military Employments, ours being subject to the greatest variety, one may judge of what Importance that Assistance is, which we almost entirely want.

I say almost entirely, and a little Consideration on the Knowledge of this kind necessary for an Engineer, will convince every one, that the expression is not improper.

This Knowledge consists in the Fortification, Construction, or the Art of executing a Project with proper, Solidity and Oeconomy, the Attack and Defence of Places, and what regards Field Engineering.

I include Fortification, tho' I am not insensible it has its speculative Theory, that is, Principles, or rather Maxims, which serve for Rules; the same may be said of the Attack and Defence of Places, which are necessarily connected with those Maxims. Besides, those Maxims are not capable of Demonstration; and they are so dependant on the situation, &c. of the Ground; and other Physical Circumstances, that not judging them fit to be ranked among Sciences purely speculative, I thought I might place them in this Class.

The different Parts of this Knowledge, tending almost entirely to Fortification, is without doubt the principal.

If quantity made up for quality, we should have no reason to w^{sh} for more Books on this subject; what a Number has already appeared? Most Authors

P.R.E.F.A.C.E.

thors have thought to reform the whole on new Ideas, by needlessly and often improperly changing the inclination of one Line; others, to distinguish themselves more, have imagined the most monstrous Figures, enticed thereto by the Ease of doing it.

Writers of all Degrees and Professions, even those most incompatible with Arms, have prescribed Methods and Rules, and this Jumble of useless Pieces has been honoured with the Name of System. (a)

I know that in the Number of Authors, there are found Engineers of established and respectable Characters, such as the *Chevalier de Ville*, *Count de Pagan* and *Barron Coklorn*; I am far from confounding them with the others, but it is plain their design in writing was less to inform Pupils, than to get some Ideas, either new, or essentially differing but little from what was already known, approved by Conniseurs.

One must not be surprized that in the vast Number of Books, there are not perhaps four worth reading throughout, and not one in which are found all the necessary Instructions which might be contained in a Treatise of a moderate size.

Construction is an Art which includes so many different Objects, and depends on so many Circumstances, that few Authors have treated of it, and none in a Manner sufficiently instructive, or extensive: We have nothing compleat in this kind. An Engineer is often obliged, for his instruction in so important an affair, to his own mistakes, which are always attended with useless Expence.

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(a) The *Count de Montecuculi* was much of the same way of thinking, he says in Book I. Chapter 5th " But how many different Combinations may be made of the reciprocal Proportions of those Parts? How many Authors have treated of them? How different are their Discoveries? They are infinite and tiresome in those Authors, who have been only Copylers, or Copied one another, or have only chimerical Ideas without Practice.—It is a *Proteus* changing into a thousand different Forms."

We are much more fortunate in regard to the Attack of Places : The Mareschal *de Vauban*, who invented, rather than perfected this Art, has wrote on it as extensively, as solidly : Since that valuable Manuscript has been Printed in *Holland*, there is nothing essential to be wished for, on that Head.

That great Man, in 1706, wrote a Treatise on the Defence of places : Nothing indifferent can come from so a Masterly a Hand, the Work is worthy the Reputation of the Author ; but our Conquests, continuing almost without Interruption, not having given him an opportunity of exercising his Talents on this subject, as on the other, and it being an Object which consists chiefly in Chicanery, or Stratagem, and therefore subject to much more variety, it is thought that nothing can be retrenched from the Work, but much may be added to it.

Besides, this Manuscript (for I am not talking of what is published at the End of the Attack) is so scarce, that there is little probability of its being soon printed.

Altho' most of those, who have wrote on Fortification, have treated of that part which concerns the Field, I believe I may, without exaggeration, assert they have said nothing to the purpose.

What does it signify, in treating of such a subject, to give a Plan and Profile of Lines in ordinary Ground, to shew how to raise a Redoubt, or flank a Piece a little more extensive, often contrary to the Rules of right reason.

This kind of forgetfulness, has proceeded from different Causes ; Cabinet Authors, to whom the Combination of a few Angles and Lines, gave room to display their skill in fortifying Places, not being able to treat of this subject, founded almost entirely on practice, have abandoned it to People of the Profession.

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They took the most prudent part ; but the Conquests of a Reign, for a long time happy, were not Circumstances proper, for perfecting an Art, whose principal Object is a defensive War. It must also be observed, that a Brigade of Engineers was then thought sufficient for an Army, and this Brigade consisted only of six, and the same Persons were generally employed.

Thus our own successes were an obstacle to our Instruction; and it is not surprising, that in the small Number of Men that had afterwards an opportunity of improving themselves, the Talent of arranging and expressing their Ideas, or an inclination to publish them, have not been found united with the necessary leisure and experience.

After shewing in what we are deficient, I may be allowed to hazard what I think on the manner of remedying it.

Though Fortification of Places, as important as it is, as well in itself, as in its connection with the other Parts of this knowledge, is, to speak in general, that to which Engineers least apply themselves.

This indifference probably proceeds from their having learned it by rote, without Principles, which a Master little skilled in the Art renders respectable by the Name of the Author, from whom he borrows it; and which makes them consider it as confined, or already carried to the utmost Extent it is susceptible of.

That a Science, so much neglected by those whose Interest it is to apply more to it, should have employed so many Pens, is a Consideration insufficient to remove this prejudice, and I may venture to say, that the uninstructive uniformity, or disgusting whims of so many different productions can only confirm it, and give a distaste to such a study.

Ideas more methodically ranged, or more extensive, learned at School, or immediately after, would give more insight and a better taste for a Point so essential. I could wish, some Person of Capacity or Knowledge, would begin by explaining the different Parts which form the Front of a Fortification; for Example, to describe a Rampart, Ditch, Cover-way, lay open their uses, what should be their height and breadth, the Advantages attending their being increased, or diminished; let him afterwards treat, with the same attention, of the whole inclosure, the different regular Figures, and the outworks used to cover the Body of the Place; then shew how to draw a Plan after the principal Systems already known, examine them strictly, and exactly weigh their Advantages and Defects, and shew by the little difference among those Systems, the small progress yet made in this Art; he should then conclude by laying down general Maxims, and shewing how they ought to be applied to irregular Figures.

I am persuaded such a Work would produce very different Notions, and Ideas, of Fortification, from the present ones; and was it better known, it is probable it would be more cultivated. If Practice be indispensably necessary to form an Engineer, it is principally in regard to Construction; and tho' I own this necessity, it cannot be denied that in this Case, as well as others, some Treatises wrote with care, would remove the greatest difficulties. When personal experience is necessary, but for want of Opportunity cannot be obtained, is it not a great Advantage to be enabled to profit by that of others? How useful would be a Collection of Instructions, chiefly drawn from projects, and Schemes, and enriched with Plans, Profiles, and Designs of the different kinds of Works, erected in France, since the Establishment

ment of the Corps of Engineers? I may venture to say that, not only young Engineers, but all others would benefit much by such a Work.

Suppose, for Example, any one is directed to build a Bridge over a Precipice or to construct a Sluice or a Reservoir on a considerable River, what better Models could be followed, than what has been lately done at Briancon and Mentz.

All the necessary Materials might be found in the Engineer's, or Publick Offices, and in the Hands of the Directors. The Engineer charged with this important Work should draw all the Plans, and arrange and unite the different Parts, which should be furnished by those appointed for this undertaking.

Many Works now hid, or forgot, would then come to light, and be of publick, and lasting use, and save the Crown vast Sumes, daily thrown away on defective, or ill contrived Buildings.

It is plain that I suppose the Interposition of the Government, but can there be any doubt, of its Assistance to carry so useful a Project into Execution.

A Copy of *Marechal Vauban's Memoirs*, carefully compared with the Original Manuscript, would be an excellent basis, for a compleat Treatise on the Attack of Places.

I would have joined to it, by way of Commentary, all the Remarks and Additions that should be thought necessary, or useful. That Author's first Memoirs, some printed Books, the Writings of the best Engineers, and the most remarkable Passages, taken from the Journal of Sieges, would furnish ample Materials for such a Work.

The same Method might be taken with that General's Memoirs on the Defence of Places, or, if thought necessary, it might be new modell'd.

In distinguishing, as I have done, the Attack and Defence of Places, from the functions of a Field Engineer, it appears at first Sight, that the difference

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ence is so little as scarce to be thought any, but my own experience has convinced me of that Error, and I have imagined, that without quiting the Subject, Materials may be found for a Treatise, as full of Variety, as new, and instructive.

When one considers, that of the five Parts of Practical Theory, there is scarce one, on which much more may not be desired, there is no avoiding surprize at a neglect, so prejudicial.

It is certain, that what concerns the Construction cannot be clearly treated of, but by a well judged Collection of what the greatest Genius have practised for several Years past, which requires the Assistance and Authority of the Government; but it might have been asked, and it is evident the same Excuse cannot be alledged for the other Parts.

In vain do we seem to expect from other Hands, that Assistance, which our Corps alone is capable of giving us: It must be an Engineer that can write well on this Subject, and I may venture to say that being no less Men of Council than Military, it is not more honourable than advantageous to us, to leave to Strangers, the care of our Instruction.

These Considerations induce me to speak by Example; but proportioning my Task to my Leisure and Capacity, or perhaps enticed by the Novelty of the Subject, I at present confine myself to the ordinary services of the Field, in which I have the Advantage of some Years recent Experience.

As Temporary, or Field Fortification, is the first and principal part of this Service, its Theory shall be the Subject of this Volume.

If it be well received, I may be tempted to go on, and it shall soon be followed by a Treatise on Construction; and to render it more compleat, I will add, as far as possible, all the necessary Instructions, on the most Minute Works, and the different Commissions,

missions, that an Engineer may be charged with, in the Field. It is well known that this kind of Construction, quite different from that of permanent Fortification, is neither less extensive, or varied; and I may safely say, that I have little to seek for on this Subject.

The Instruction of our Corps, being my chief View, I shall gratefully and with docility, receive all the Advices, that may be given on the faults of this Treatise, but I think it necessary to advise the Reader of a Point that requires all his indulgence.

This is, the necessity I am often under of speaking of myself; I know that such Quotations, particularly when they regard Sciences, are seldom pardoned, they are generally supposed to be the overflowings of self Love, which wounds one's self, by arrogating a kind of superiority. The Case is therefore nice, but it must be considered, that there being scarcely any thing wrote on this Subject, that could furnish me with Examples, I have been obliged to quote what I have seen; that Field Fortification generally subsists, but a short time, and that Rank in which I served during the two last Wars, qualified me for such a distinction, that I have seen little of this kind, of which I had not the Charge.

I hope these Reasons will justify me, at least with the indulgent Reader; as to the others, they may if they please, consider what I have wrote, only as a Relation, accompanied with Reasonings, (and in a different Order from that of Data,) of what I have seen or executed in this kind: However this Fault, if one, falling only on the Author, will not diminish the utility of the Book.

I have but few Words more to add: My reason for putting a general Preface, before a particular Treatise; if I am supposed not to design writing successively on the other parts, it must be allowed, that

that it may be of service, in exciting other Engineers to it : Such a Motive justifies the rest ; and if it produced so good an Effect, would it not be more useful than the Work itself ?



THE

Practical Engineer and Architect's Companion, for the Use of Civil Engineers, Architects, Surveyors, Architects, Builders, and others, engaged in the Practice of their Professions.

With a short time since past, in which I have been labouring to make a

few sketches of my own, I have now made up my mind to publish them.

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THE F. E.

T H E
FIELD ENGINEER.

CHAPTER THE FIRST.

- I. Of Field Fortification. II. Its particular Maxims.
- III. Defeats of salient Angles. IV. Means of correcting them. V. Of Redoubts; their most perfect Figure.
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I.

THE Art of Fortifying, Constructing, Attacking and Defending *Places*, comprehends without Doubt, the most essential and most brilliant Parts of a good Engineer; but his Reflections must not be confin'd to these Objects only.

An Army intrenched with Judgment produces in many Respects, the same Effect as a Fortress; it covers a Country, supplies the want of Numbers, stops a superior Enemy, or obliges them to engage at a Disadvantage.

Supposing on the contrary, we were Masters of the Country, there are Posts, Heads of Bridges, Quarters to secure, and other Works to construct.

This Knowledge being founded on the Principles of Fortification, it must be allowed that this Science is as necessary with an Army in the Field, as in *Places*; but although the Maxims be essentially the same, the Manner of applying and executing them with Judgment, is very different.

A Project in one of these Cases, is commonly the Produce of a long Meditation; the Engineer plans, digests, and examines it in his Closet; he compares at leisure his different Ideas, and provided the Work be solid and durable, being neither distressed for Time, Materials, nor other necessary Means, he knows he cannot fail in the Execution.

In the other Case, every Thing differs; without regard to Solidity it must be determined on the Spot, and immediately traced out; the Work must be regulated according to Time, and Number of Workmen; depending on no other Materials, than what are directly before you, and all your Tools the Shovel, Pick and Axe.

It is therefore in the Field, more than in any other Place, that an Engineer, ought to have *le Coup d'œil juste*, to know how to seize on all Advantages at first Sight, to be fertile in Expedients, inexhaustible Inventions, and to appear indefatigably active.

This Vivacity and happiness of Imagination are natural Talents, yet they are almost useless without Assistance of acquired Knowledge, this Knowledge may in part supply them; and to contribute to it, as much as possible, is the Design of this Work.

II. We cannot better begin, than by adding to those general Maxims of Fortification, in which I suppose the Reader perfectly instructed, some particular Maxims, which we will here lay down as Rules.

First, to inclose within the Works as much Ground as possible, having regard to Circumstances.

This which principally concerns Redoubts and small Forts, is necessary for Post Guards to lodge themselves, and to move more commodiously; and on the other Hand, that the Troops may be less crowded in their Camp, or different Manoeuvres.

Secondly, If there are Works to be carried on from one to another, that their Lines of Defence be so directed, that they may reciprocally defend each other, without annoying themselves by their Fire.

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The Advantage of the one, and the Inconvenience of the other of these Points, are too evident to need an Explanation.

Thirdly, not to depend on the Defence of small Arms, but where they can rake, or fire on, at Right Angles.

Because the Soldier, generally fires without Aim and Right before him.

Fourthly, not to have Recourse to the second Flank, or Fire of the Curtain, but when it cannot be avoided.

This Maxim is in Consequence of the preceding: We shall find in Article III. of the following Chapter, that the real Defence of this Curtain, must not be estimated by the Length of the Oblique Flank, but is reduced to that of a Perpendicular, let fall from its Extremity on the Line of Defence.

Fifthly, That the Flanking Angle, that is, the Angle which forms the Flank with the Line of Defence, be always a right one, or more, but never to exceed 100 Degrees, if possible.

We need not fear the Angle, being too open here, as in *Places*; we need neither endeavour to fire directly on, nor to graze the Faces, since we are neither exposed to the Defence of a Breach, nor Lodgment of a Miner: We must guard against a sudden and rash Attack, commonly made open, and in Column, by a superior Enemy, which we should have great Difficulty to oppose, if they once got over the Ditch; it is therefore our Business to stop them at some Distance, and not to multiply the Danger, by exposing ourselves without Necessity to our own Fire, which unavoidably happens, if the flanking Angle be acute, because in these confused Times, the Fire is very ill directed; yet at the same time we must avoid the opposite Extreme, of making the Angle too obtuse; for in this Case, the Fire does not defend the Ditch, it flies off

too much from the Work, it crosses less on the Saliants, or does not cross at all: For these Reasons, rather than lengthen the Flank, I prefer, when convenient, the Angle of 100 Degrees, to a right one.

Sixtly, That the flanking Parts be sufficiently salient, so that the interior of their Parapets at least rake all the Breadth of the Ditch of the opposite part.

When the Enemy are near, especially in Column, a direct Fire seldom stops them: in the Ditch they are under Cover, that of the Flank, is then the only Resource, therefore we cannot attend too much, to a Part so essentially assistant.

Sevently, Never to make an advanced Ditch in dry Ground, if it is not open and enfiladed throughout, and under an Angle proper to be defended, with the Work which covers it.

Works without Flanks, such as Redoubts, and those where the Flanks are too oblique, or have not a sufficient Salient, are in my opinion, the only ones, to which we may not add advanced Ditches. I know that this Maxim is directly contrary to that of *M. de Vauban*, who in rejecting them, has expressly excluded the Lines; but in this he was determined from the apprehension lest they might serve as Shelter to the Enemy, to draw up and take Breath; certainly, the Inconvenience being removed, as I suppose it here, and shall give the Means to do it hereafter, his Objection cannot hold, and the advanced Ditch must be esteemed as a greater Obstacle to the Enemy.

Eighthly, Not to allow more than from 60 to 80 Fathoms for the Lines of Defence, when they proceed from two Flanks separated by Branches, which form a salient Angle, or when not made to cross even by prolonging them.

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As the flanked Angles of Polygons in the first Case, are the Parts most expos'd, they cannot be too well supported; the second, particularly concerns the *Cremailles*, or indented Works, where the Defences being parallel, and directed the same way, cannot cross; to remedy this, that of the Crotchet ought to be cover'd and doubled by the Fire of the preceding Crotchet, as may be seen in the Article of Lines.

Ninthy, That the most projected, or salient Parts, consequently the weakest in themselves, be as much as possible, the best defended, and have at least the Fire of two Flanks, besides their own direct Fire.

III. All Fortification consists in plain Figures or Lines only, that are, or may be put into a state of Defence.

A Line is not fortified, but as it is flank'd; Fortification therefore necessarily supposes Angles, and consequently salient Angles.

If the Angles be rectilineal, they have the Advantage of others, in being defended and grazed in all Parts; this must be clear to every one, yet in my Opinion their Defects have not been minutely attended to.

The Soldier generally fires mechanically, and consequently right before him; Experience has so often convinced us of this, that it may be laid down as an Axiom.

From hence then, at the Point of each Salient Angle, there is a considerable Space which is not raked by any direct Fire, for I look on one Man that may be placed there, as nothing.

We shall find this Space to be the Sector of a Circle, whose opening is the flanked Angle, and its Radius the utmost Range of a Musket Shot; so that this Angle being a right one, and the Range of Shot 150 Fathoms, or 300 Yards, there are

Pl. 1.
Fig. 1.

almost 17679 square Fathoms of Ground, where the Besieger has no Fire in Front to fear.

It is by this Knowledge, often very superficial, that Trenches are conducted, as much as possible, on the prolongation of the Capital, and that skilful Officers direct their March, as well for the Attack of the Covert Way, as for that of any other Work.

IV. Some Engineers, to remedy this Defect, round the Angles, which throws the Fire equal-

- Pl. 1. Fig. 2. ly throughout: This method is preferable to the common Construction, but the rounding being of little Extent, for fear of lessening the place of Arms, or the Work, the Fire becomes very small and scattering.

As this is the Capital, which being most distant from the flanking Parts, has most occasion to be defended, I would rather cut the Angle off by a right Line.

Both these Methods do only diminish the Defect, the following is easy to practise, at least in *Places*, and which effectually remedies it.

- Pl. 1. Fig. 4. Trace the interior Part of the Parapet *en Cremainières*, or indented, observing that one Face of each Redan be perpendicular and the other parallel to the Capital: A Construction that seems to me the most advantageous, as two, or three different Defences are drawn from the same Part.

M. de la Fon, Director of Fortifications of the maritime Places in *Flanders*, shewed me, in 1740 at *Dunkirk*, a Project of this kind in tracing a Covert Way: *M. de Verville* formerly in Chief at *Rocroi*, to whom I had not spoken of it, shewed me the Plan of a Redoubt, at the Army of the lower *Rhine*, where he had proposed to defend the Angles by this means: So useful a Discovery cannot but do these Gentlemen Honour.

V. A Redoubt is the smallest Piece of Fortification that is constructed: I comprehend under this

Name

Name, every Field Work, not flanked by itself; they are of two Sorts, one with a Parapet, the other a * *Machicoulis*: This is seldom practised in the Field, yet I saw one in 1734 at the Lines of *Etelingue*; it was an exagon of Timber-work, which served for an Intrenchment and *Corps de Garde* to a more considerable Work.

Redoubts with Parapets are more frequently used; they serve in the Defence and sometimes in the Attack of Places, and frequently in that kind of War, we are now treating of.

When there is no particular Reason, their Form is commonly square, observing to oppose one, or two Sides, as direct as possible, to the Places to be commanded.

If the Redoubt be within Reach of other Works, such as a Covert Way, or Lines, its Faces must be turned so as to be defended.

It is yet necessary in this Case, to join altogether by a Communication: Besides the Assistance and Retreat secured by this, it has the Advantage of not being attacked in Rear, but with great Difficulty.

A Communication well made, may besides give right and left Flanks to those Parts by which the Work is protected, as we shall find in Chapter VII.

We have shewn of what Service it is to remedy the Defects of salient Angles in general, we may add, in regard to Redoubts, that it is not only useful, but necessary.

* *Machicoulis*, or rather *Maffecoulis*, is an old Word, still applied to Projections in old Castles and over old Gates of Towns, left open at bottom, to throw down Stones, &c. and to hinder the Enemy from sapping. To give the Reader a better Idea of these kind of Redoubts, I have here added a Plan and Profile of one constructed at *Dunkirk* by *M. de Vauban*.

In fine, from what has been said on this Subject, we may conclude that the Surface which the Piece rakes, or fires on, is to that which it does not, as the Interior of the Polygon multiplied by the Range of Musket Shot, is to the Superficies of a Circle, whose Radius is the Length of the Shot: So that, supposing this Range of Shot, always to be 150 Fathoms, there is, about a Redoubt of 40 Fathoms interior Parapet, a Space of 6000 square Fathoms exposed to its Fire, and more than 70714 that are not.

As this Rule is general and the Number of Sides makes no Difference, it may appear, that a Circle has not more Advantages than another Figure, because it is only a Polygon of an infinite Number of Sides; which merits some Examination.

Altho' the Space a Ball goes thro' has no greater Breadth than its Diameter, as the Object on which it fires has more than that, I will suppose it sufficient to fire on a Breadth of two Feet.

If the Redoubt has forty Fathoms interior Circumference, its Fire will form 120 Paralellograms, which touching each other by the Extremities of the small Sides, leaving between the great ones 120 Sectors, which altogether form, as in the Square, a Circle of 150 Fathoms Radius.

Consequently then, we may not only consider the Circle, as a Polygon of an infinite Number of Sides, but as one of 120 only.

I agree to these Facts, which prove the Rule I laid down extends to circular Figures; but I am convinc'd that this Figure, is preferable to the rectilineal one.

In the Square for Example, there are only four Spaces which are not defended; but each of them open at right Angles, and consequently near 17679 square Fathoms; whereas, by this supposition, I have in fact 120 Spaces not defended

fended, but each is less than 590 Fathoms superficies, and drawn from an Angle of three Degrees only.

However great this Advantage may be, there is one much more considerable; it is, that all the Points of the Circumference of a Circle, being equally disposed, the Soldier posts himself indifferently throughout; which makes the Spaces defended vary every Moment, and the Enemy is secured in no particular Part.

We may then certainly conclude, that the round Redoubt tho' little, or not at all used, is the most perfect we can trace; that the fewer Sides these Works have, the more defective they are, and that the Contents of the Spaces not commanded being the same in all Cases imaginable, the larger they are, the less this Disadvantage is in Proportion.

The circular Figures, though very good, can not be used, but on certain Occasions; if for Example, it be required to fire on an Object of small Extent, without doubt a Front must be opposed, whose Fires will be parallel to each other; that is, they must proceed from a right Line; other Circumstances require a mixt Figure, but in all these Cases, regard must be had to the Defects of the Angles.

The most infallible Method, doubtless, is that Pl. II. we quoted at the End of the preceding Article: The Defect not only disappears by that ingenious means, but also that Part becomes stronger than the Side itself, as the Extent of its Defence is equal to that of the Diagonal: yet as the Face of the Redan ought not to be much more than three Feet, it appears difficult to execute it without some sort of Revetment, (a) which we have seldom time, or means to make in the Field.

We

(a) A Facing of Brick or Stone.

We shall therefore often find it necessary either to cut off the Angle by a right Line, or round it; if the latter, the rounding should be as large as possible; and it must be farther observed, that the more elliptick it is, the more it will throw the Fire towards the Capital.

VI. The Size of the Redoubt is sometimes determined by the Situation of the Ground, but more commonly, by the Number of Men destined for its Defence.

A Parapet is well lined with two Men to every Fathom; this Knowledge is necessary, but not sufficient to determine the Subject of this Article.

Forty Men for Example cannot, because of the Banquet, be contain'd in the *Terreplein* of a square Redoubt of five Fathoms interior Parapet for each Face, and 160 will be too many for that of twenty Fathoms in each Side; because in similar Figures, that whose Side is four times less than another, has 16 times less Contents.

Therefore Regard must be had to the Extent of the Circumference, and the Surface at the same time.

A Redoubt of twenty-four Fathoms Parapet, that is, if it is a Square of six Fathoms interior Parapet in each Side, is the least that should be used.

On the contrary, they should not exceed 64 Fathoms, that is 16 in each Side, for as these Pieces have no Flanks, it is better, when we would have a Work of a considerable Extent, to throw up little Forts, which we shall speak of hereafter. A Remark, which probably escaped the Notice of the Engineer, charged with the Construction of the Lines of *Etilingue*; for towards the Extremity of the Left where we forced them, I saw a Redout of about forty Fathoms in each Side: It was in this gigantic Piece, that *Macbicoulis* of Timber was which I have alre ady mentioned.

A Redoubt

A Redout of 24 Fathom interior Parapet will contain 36 Men, and they are sufficient for its Defence: that of 64 Fathoms will not be crowded, and will be lined two deep with 256 Men. But the Numbers of 36 and 256 are the Square of 6 and 16, that is the fourth Part of the Extent of these Pieces: We may then conclude that if we quadruple the Square Root of the Number of Men, which may be destined for such Works, it will give the Extent of the Circumference in Fathoms.

If on the Contrary we would know the Number of Men a Redoubt can contain, we need only square the fourth Part of the Fathoms of its Extent or Circumference, and the Product is the Number.

For Example, what Dimensions should be given for 100 Men? multiply 10, the Square Root of a 100, by 4, it will give 40 Fathoms for the Extent of the Parapets of all Sides: On the Contrary, multiply 10, the fourth of the Extent, by itself, the Product of 100 is the Number it will contain.

Large Redouts by this Rule, contain, in Proportion, more than the small ones; but this must be an Advantage, since they are not constructed, but in Places of Importance, or those most exposed, and if it should be thought proper, the Number may be diminished. This Method is sufficient in Practice for Figures from 24 to 64 Fathoms Parapet; but it must be remembered that the Extent being equal, that which has most Sides, can contain the most.

The use of Redouts in the Field, is commonly to secure a Post, a grand Guard, or Communication; to defend a Defile, a Bridge, or a Ford; they may be useful also in flanking Lines, as we shall find hereafter.

They

They may be also necessary in some Cases to keep the Enemy at a Distance from some considerable Post. In 1734, after the taking of *Philippsbourg*, we scarcely dared to graze our Horses 100 Fathoms from the Pallisadoes : The Hussars carried off and kill'd an Officer at the very Foot of the *Glacis*, and the Imperialists, Masters of that Side of the *Rhine*, marched in broad Day and pass'd their Baggage over the Capucin Hill within Cannon-shot of the Place.

I repaired two old Redoubts on the Side of the Hill, and constructed a third ; the Hussars appear'd no more, we kept our Pasture and they march'd off thro' the Wood.

C H A P.

CHAPTER THE SECOND.

- I. Of Field Forts in general. II. Of Star Forts. III. Of Second Flanks. IV. Of Triangular and Square Forts. V. Of Heads of Bridges. VI. Their Figures according to different Cases. VII. Those of a more durable Construction, VIII. Scheme of moving Flanks. IX. Other Uses of arm'd Boats.

I. FORTINS, or Field Forts, have the Advantage of Redoubts, in being flanked, and the Disadvantage in containing less within, in Proportion to their Extent.

We may consider them of two Kinds : The one defending itself on all Sides, is entirely surrounded, and is what properly falls under this Name ; the others, bordering on a River, Precipice, &c. remain open at the Gorge.

Some Cabinet Authors, for want of Experience, have given pitiful Designs on this Subject, and sometimes fall into gross Mistakes and Absurdities, in the tracing of them.

These Forts, as all the rest, are regulated by the general Maxims and Principles I have given ; observing in Consequence of those Maxims, never to construct a Fort, under a certain Size : It is better in that Case to erect a Redoubt, in order to preserve its greatest Capacity.

The Size, and Construction of these Works differ, according to the manner in which they are to be fortified.

II. The

II. The most simple is to (a) Brisure the Lines in Rentrant Angles, which gives oblique Flanks, without Shoulders.

By our general Maxims we shall find, that the Obliquity of these Flanks is often of great Effect; it is more or less defective as it exceeds the Angle of 100 Degrees; and no regard should be had to the dead, or reentrant Angles which they form.

These are called Star Redoubts, because they resemble that Figure; *Adam Fritach*, who, on this Subject, quotes the Siege of *Breda*, says they are commonly made of four Angles, sometimes of five, and very rarely of six.

Pl. III. Fig. 1, 2. He constructs them by giving to the Square one Eighth, and to the Pentagon one Sixth of the Length of the Side, to the Perpendicular which forms the Brisure.

The Flanking Angle in one, is thus 152 Degrees nearly, and more than 143 in the other: As they cannot be closed much more, no great Protection must be expected from these Flanks; the Fire crossing at a small Distance, the Polygon is without Doubt better defended, than by a Right Line; but the Salients, especially in the Square, are too much exposed.

Pl. III. Fig. 3. *Fritach* says nothing of the Construction of Stars of Six Angles: *Father Dechalles* forms them of equilateral Triangles; this Figure is regular, and I believe is the most perfect of its kind.

The Flanking Angle being thus 120 Degrees, the Fires cross better and farther off, and as the Flanks are on the same Line, the Space not defended before the Salient, is reduced to a Paralelogram, whose smallest Side is equal to the Gorge.

Pl. 4. Fig. 4. We may rank with these, Stars of eight Points, which the Author before mentioned calls a Square; It

(a) To Brisure a Line, is to make it with one or more Angles either Salient or Rentrant; the Line serving for the Base.

It is in effect a Square, where the third of the Side serves as a Base to an equilateral Triangle, which flanks the rest.

This Figure has the Advantage of the preceding, in containing most, and crossing its Fires on the four right Angles: As to the Redans, the Breadth of the Space not defended, is as in the other, perpendicular and equal to the Gorge.

If we compare these different Figures, we shall find that the Defence increases, as well in Front, as on the Saliants, in Proportion to the Number of Sides; therefore says the *Dutch Author*, the Star of six Points is preferable to that which has less, and that of eight Points is preferable to that of Six.

Their most perfect Construction, is to form on each Side of an Octagon, an equilateral Triangle. The Figure is regular, its flank'd Angles are 60 Degrees, and its flanking 105, which is not too much; but as it is not very easy to trace this on the Ground, the following comes very near it.

Brisure the Sides of a Square, giving one Eighth of the Side to the Perpendicular, as in the Star of four Points, and elevate on each Front an equilateral Triangle, the third of each Brisure serving as a Demi-Gorge.

The flank'd Angles by this become alternatively 61 Degrees 56 Minutes, and 60 Degrees; and the flanking Angles 105 Degrees 58 Minutes. I executed this Piece in 1743 on the Queich, and it was approved of.

I think therefore, they should be limited to this Number of Points; it is very difficult to trace them, and useless to the Defence, if they have any more.

III. The Construction of bastion'd Forts, differs in nothing from that of Places, except that the Figure being smaller, and the Attack supposed of another kind, it is reckoned sufficient to flank them with half Bastions.

The

The Face of half Bastions draw their only Defence from what we call the second Flank, that is, from one part of the Curtain; on which we must make an essential Observation.

We have shewn, that the Soldier generally fires directly before him; tho' this is an important Point, we will take no Notice of it here, but suppose on the contrary, that he fires in the proper Direction.

I shall not enquire into the Advantages, and Disadvantages of the second Flank, so much esteemed by the *Dutch*, such a discussion tho' necessary in a general Treatise on Fortification, would be misplaced here; I shall confine myself therefore, to the effect of this defence.

Pl. 5 Fig. 1. ~~So many~~ Authors approving of them, gives room to think, that some of them suppose this Defence to consist in the Length of this part of the Curtain, instead of which, it is reduced to the Length of a Perpendicular let fall from its Extremity on the Line of Defence.

If we suppose two or three Feet Interval between each Musket, the Distance of a Parallel to another being to be taken perpendicularly, it is evident, that the second Flank, will give no more Fire than that Perpendicular we have spoken of. That is, if the Length of the second Flank be 54 Feet, and the flanking Angle, as I suppose it in a triangular Fort, 166 Degrees 6 Minutes, there will not be 13 Feet real Defence. The Figure will explain this much better, than what can be said of it.

IV. This second Flank, which, after all, we are obliged to have Recourse to here, is smaller and more oblique in the triangular Figure than in the Square; the triangular Figure contains less in Proportion, which is a Disadvantage according to our Maxims; for this reason we avoid using them if possible, yet as Circumstances sometimes oblige us to it, the following is the best Method of fortifying them.

Form an equilateral Triangle; divide the Side Pl. V.
Fig. 4. into three equal Parts, one of these laid on the Pro-
longation of the Side is the Capital, draw the Line
of defence from this Point, to the extremity of the
Triangle; make the Gorge equal to the Capital,
that is to one third of the Side; raise the Flank
perpendicular according to *Fritach*, or rather about
10 Degrees more open, as in the Plan annexed.

The Square is fortified the same way, excepting
the Angles of the Polygon, being more open, in
Proportion to the Number of Sides, the Line of de-
fence is drawn from the middle of the whole Front,
that is, from a Point taken one third on the Cur-
tain, counting from the Demi-Gorge to the Angle
of the adjoining half Bastion.

I shall not here produce a multiplicity of Exam-
ples, nor extend to irregular Figures, much less to
those fortified with whole bastions; it is for the
use of young Engineers I write; as for those Offi-
cers who have made this their principal study, I
have perhaps said too much already.

Pl. V.
Fig. 3.

V. Forts open at the Gorge, serving generally to
cover the Heads of Bridges, are very seldom left
to their own defence only.

For which reason, when the Bridge is not made,
they are commonly constructed, at the middle of
an Elbow, which forming a kind of Arch, have
a better defence than a right Line.

If the River is narrow, and the opposite Side
as high, or higher than that on which the Work is,
detached Flanks are raised, whose effect is the more
certain, because the Soldier is not afraid of being
attacked there.

If the River is broad, that is 40, or 50 Fathoms
wide, and the Sides being low oblige us to run to
such a Distance, that the small Arms will do Exe-
cution before the Salients, the Faces, must be sup-
ported

ported by flanks, which are raised on the shoulders of the Work, or flung up at the instant of the Attack.

The Rhine below Straßburg, the Danube below Ingolstadt, and many other Rivers, are above 100 Fathoms broad, in which Case, we must not expect any Protection from small Arms, from one Side of the River, to the other, but the Flanks before mentioned will always be useful, if some Pieces of Cannon are placed in them.

As Artillery is absolutely necessary in this Case, and as they are certainly the most proper Arms to defend the Access to a Work at a Distance, we shall not find them much less necessary in the others. An Engineer, should then demand them, as they have often been of Service in these Cases.

VI. The Size of these Pieces is not determined by the Number of Men destined for their ordinary Guard, but rather by that of the Troops that are, or may be advanced, because they must be so constructed, that they may file off without Confusion, and must also favour their Retreat.

The principal Circumstances, which can determine their Figure are reduced to three different Cases.

Pl. VI: When these Pieces are near enough to be flanked from the opposite Shore, a simple Redan may be sufficient: The inclination of the Faces is according to the Ground, and the Parts to be commanded. There is nothing more to be observed, but in proportion as the Angle differs from 90 Degrees, the capacity of the Work diminishes, and the more it is acute, the more direct and nearer its Faces are protected.

Pl. VII. When our defence is from small Arms at a great Distance, Flanks must be added to the Work itself, observing to scour the Faces of these Redans, from the other Side of the River.

These

These Faces will not be too long, (no greater opening than necessary being given to the Gorge, to preserve an easy Communication) if the Angle of the Flank with the Branches be about 110 Degrees. I executed the design here given, at *Donaustauf*, near *Ratisbon* in 1742, but I had not time to make the Intrenchment in the Island which was very low; I suppose it here on a level with the Country.

When we have no other defence than Cannon, all Parts of the Work, except next the River, being equally exposed, they must be as equally flank-ed as possible.

Here are two Works which may serve on such pl. VIII. occasions: Form a square; divide each Side into Fig. 1. four equal Parts; take internally one of these Parts for the Capital; trace the Curtain; take one of these Parts for the Gorge, draw the Flank perpendicular to the Line of defence.

For the Branch, give to the Capital and the Gorge one fourth of the Side, as in the Front, except that the Capital be carried externally: draw the Line of defence from its Extremity to the middle of the whole Front; from the Point of the Gorge elevate a perpendicular; prolong it internally half of its Length, and from the Point of prolongation draw the Branch and Flank, making an Angle of 105 Degrees.

As this Figure differs in many things from what has either been executed or published in this kind, I will add some reflections.

The Flanks are very large, but the *Terreplein* being of a sufficient Extent, and the flanked Angle open enough, I see no Disadvantage in this: Those of the Front are perpendicular to the Line of defence, not diminishing, nor decreasing the Service of the Flanks by being so, as their Fire crosses in Front: the others are more open, to give the Fire at the Extremity of the Branch the more play.

The Inclination of the Branches is yet more par-ticular; I draw two Advantages by it: First, sup-

posing the course of the River in a right Line, their Fire falls before one Part of the Demi-bastion of the Gorge ; the second, that the defence of the second Flank, which should graze the Faces, is less oblique.

The second Flank by this is shortened, but if we recollect in what manner we should estimate its Fire, we shall find that in regard to the grazing Line, its effect is always the same.

Pl. VIII. Fig. 2. The second Figure, has its Front traced as the preceding ; cut off one sixth of the opening of the Gorge ; carry two of these sixths on the Branch; and from that Point forming an Angle of 120 Degrees, draw the Face of the Demi-Redan.

This method appears to me preferable to the first, if we are not to be protected from the other Side of the River, as the Branches are better defended and have Faces : The flanked Angles of the Demi-bastions are 62 Degrees 6 Minutes, which is sufficient.

These different Heads of Bridges are to be esteemed as Works good against a *Coup de Main* only, and their Use almost momentary, as they sometimes serve for a few Days only, and at most during a Campaign.

VII. There are some made more durable, such are they, we commonly Construct before *Hunningen* and *Fort Louis*, and the Enemy before *Philippsbourg*, at the beginning of a War against the Emperor, or some other Power of the Empire.

The only one I was ever employed in, was raised in 1733 after the taking of *Keel*, in the Island of *Selingue*. I was, as Chief of the Brigade, charged with its Construction, but I did not trace it ; it was a Horn Work, and I do not remember its Proportions, nor how the Branches were defended, sufficiently to give it here as an Example.

We must observe in general, that as these little Fortresses are designed to subsist 'till a Peace and often-

oftentimes can expect no Assistance but from some neighbouring Garrison, they must be not only constructed with solidity, but fortified, so as to support a regular Attack, long enough to be supported from a considerable Distance.

That which cover'd the Bridge of *Philippsbourg*, in 1734, was a Horn Work, of 45 Fathoms in Front, with a half Moon, and its Branches which form'd salient Angles were flanked by Demi-bastions: we frequently find Figures of this kind on the *Rhine*: If either of the Constructions I have given should be used in the like Case, the Front must either be more than 60 Fathoms, or the Faces very long, without which the Half-Moon will not be sufficiently defended.

As these Works are commonly plan'd and executed more at leisure, than the others, the whole Art of fortifying Places may be here practised: In 1742 I projected the half of a Square for the Bridge of *Deckendorf*, the *Danube* forming the Diagonal; but an epidemick Disorder then frequent amongst the Soldiers, left scarcely Men enough for more indispensable Service. This Figure is of great Extent, and encloses but little Ground; Circumstances which joined to some others, made me prefer one to it, which I shall speak of hereafter.

This Half-square was Constructed according to *M. de Vauban's* Method, excepting, that having no reason to fear the Line of defence would be too long, I shorten'd the Faces, to lengthen the Flanks, which I made, for the Reasons already mentioned, perpendicular to that Line.

The Front of the Polygon was 60 Fathoms, and 'tis the least this Figure can have for Field Fortification. They will be acknowledged to be right, if we reflect on the Minuteness of the Flanks and *Terreplein*.

The Work which cover'd the Head of the Bridge at *Philippsbourg*, after the conquest of that

Place, made by the *Dauphin* in 1688, was larger but similar to this.

VIII. A Work, of what kind soever, is only fortified, in Proportion as it has Flanks, and in the different Cases mentioned we may not always be able to give them as much Extent as necessary, without greatly diminishing the Figure: the Proximity of a Morass, a Rivulet, a very low Ground, the necessity of occupying the highest Parts, especially for the Saliants, without which the Branches, and perhaps even the *Terreplein* are exposed, are obstacles oftentimes very difficult to be got over.

This Reflection gave birth to an Idea, to supply this defect, by means, I proposed for a quite different Use: It appears to me as simple, as advantageous.

It is to equip two Boats, with two Pieces of Cannon in each, and as many small Arms as shall be judged convenient; when Boats cannot be found large enough, many may be fastened together to form Pontoons.

The movement of this Machine, is the same as our common Ferry-boat, that is, by making a Cable pass on two turning Cylinders, or Rings fastened to its side, one End of which is fastened to the Bridge, and the other to an Anchor cast at some Distance in the River.

If the Current is not very strong, the Cylinders or Rings are fastened one on each side, so as to give the side of the Boat its proper direction; but if it be ever so little rapid, the Boat will have its Head to the Current, or it will be in Danger of being drove on Shore. A Parapet of Madriers, or double Planks, may be made, if judged necessary.

If the Attack is made with Cannon, these moveable Flanks are brought behind the Gorge of the Work, and do not appear, till the Enemy shall be near enough to cover them, that they may have their full Effect. The Surprize, which the unexpected Sight

Sight of those floating Batteries, will produce in the Assailants, is another Advantage, and if they do not put them into Disorder, they will probably slacken their Ardour.

I suppose here, that the River is not so buried in its Banks, but that we can command the Country from the Boats, or Platforms; This scheme struck me at *Deckendorf*, it is practicable on the *Danube*, in almost every Part I have seen; the following Year arriving at *Wormes*, I found it done on the *Rhine*, but in a less perfect manner, for the Boats were fixed.

The great defence, and above all the surprize, were the only objects I proposed at *Deckendorf*, where, by the uniformity of the Ground, I could have given what Figure I pleased to the Work: But I believe this Expedient, is not confined to Circumstances.

IX. We frequently employ these Vessels in Places for other uses; they may also be of Service in the Field, but as this does not concern the Engineer, but as he may be called on to defend himself against them, I shall content myself with some Examples, to support what I have said.

I saw at *St. Omers* in 1710, or 1711, Boats arm'd with one Cannon, whose Carriage was on a Pivot, to turn as Occasion required; they had at the same time Galliots on the Inundation of *Conde*, and some were built in 1735 at *Strafbourg*. In fine we know when the *Imperialists* were at War against the *Turks*, we saw whole Fleets of * *Saiques* towards *Belgrade*.

The Austrians had them in *Bavaria*; and as the rout from *Nider-Altaich* to *Deckendorf* is cross a straight

* *Saick* or *Saique* is a Turkish Vessel, with a Bowsprit, small Mizen and a Main Mast, which, with its Maintop Mast, is supported at an extraordinary height, by Stays from the Top-Mast to the Bowsprit and Sides.

and open Plain, bounded in some Places by the *Danube*, and Mountains, our Army would probably have been disturbed in their March of the 18th of *August 1742*, if Count *Thoring*, who in Concert with Count *Saxe*, suddenly passed the *Isere* at *Pladling*, had not by that bold *Manoeuvre* obliged *M. de Khevenbullen*, to turn all his Attention and Forces that Way. The *Saiques* did not appear till two Days afterwards; they concealed themselves, to the Number of 100 or 12, under an Island, which is at the Mouth of that River, from whence they cannonaded our Guards of Cavalry, and annoyed our Bridge; the Hussars and Pandours over run the Plain: I had proposed on the 30th of the preceding Month to raise a Battery on that Island: It was at length done, and we saw nothing afterwards either on the Plain, or the *Danube* to the 5th of *September*, when we decamped to join the Army of *M. de Maillebois*, by the Rout of *Bohemia*,

CHAPTER THE THIRD.

- I. Examples on the manner of fortifying a Church-Yard; II. A Church. III. An old Castle. IV. A Country House. V. Attack of a Country-House. VI. Various Instructions on the different Subjects of this Chapter.

I. **B**ESESIDES Posts, which require the Works we have spoken of in the preceding Chapters, there are others which do not less demand our Attention and Judgment. They are fortified according to the Time, Numbers, and Means we are Masters of, and the use we would make of them: I will explain myself better by Examples.

The first of October 1742, having set out with twenty-one Engineers, from the Camp of Brammerhof, to go to Amberg the following Day, three leagues below Tirschenreit, we found a considerable Body of Hussars, who waited for us at the End of a Wood, and who at first kept at a Distance from us, seemingly the better to reconnoitre us.

Our Escort was only thirty-three Men of the independant Company of Limont; we were for the most part badly provided with Pistols, and the baggage was liable to put the whole into Confusion, yet being willing to go forward, we passed thro' the Village of Pfaffernreit without stopping.

We scarcely got out, when the Hussars, who had taken a Tour, briskly attacked us with Pistol and Carabine; this did not prevent us continuing our Journey with a slow Pace, and in good order, 'till we were opposite to Miteldorf.

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This Skirmish lasted above an Hour ; two Engineers were taken, one of which was wounded, and a third also, with four Domesticks, were wounded. The Enemy did not suffer less than us, but they were not discouraged, their Number encreasing every Minute ; and the more we advanced, the more we were out of the way of Assistance : these Circumstances determined us to throw ourselves into the Village.

We quickly saw what we might expect in such an Assylum ; we found neither Church nor Walls to enclose us ; this Place is a Clump of a dozen Houses of Wood, or Deal Planks laid on one another and Pinn'd at the Corners, according to the Custom of that Country. We had all the dreadful Effects of Fire to fear, a kind of Attack very inhuman, but very customary with the People we had before us, and who were encouraged by a considerable Sum, which they found on one of the Prisoners ; this made us certain that if they quitted us, it was only to return in a little time with a greater Body.

In this Dilemma, we reconnoitred and reached Vurz, a Village, in which we perceived a Steeple, and which was about the 8th Part of a league, on our right.

Having carefully examined the Avenues, and barricaded them with Trees, Baggage, Carts, &c. from each of which we took a Wheel or two, we raised a Banquet along the Wall of the Church-Yard, where we were fixed with our Baggage ; making use of the Church, in the Door of which we had cut Loop Holes, as a Citadel, and the Steeple, as a Redoubt, which must be our last Shift.

Two Stone Houses almost touched our Bounds, but being built on very low Ground, the height of their Walls did not exceed that which served us as a Parapet.

a Parapet. We would not open these Walls, and yet we must have a Communication with those Houses ; the possessing them, was absolutely necessary as well to avoid being overwhelmed, as to give us some Flanks. We therefore judged it best to Construct our Communication in form of a Bridge, from the top of the Intrenchment into the Roof, and having barricaded the Doors and Windows in the lower Floor, we here fixed our *Corps de Gard*, and all other Precautions, tho' apparently prudent were useless.

The Hussars, tired with waiting for us on the Road, returned the next Day in greater Numbers, with 100 Pandours ; but all the assistance we could get, tho' the Night was employed in writing on every hand for assistance, was no more than 5 Men of the same Company, who had not Orders to go further, and we had returned safe to *Tirchenreit* by the time they joined us.

II. The Church of *Vurz* was doubtless a more secure Post than the Church-Yard ; but as we would not abandon our Horses, nor could get them in to the Church, this Retreat required Works which we had neither time nor means to execute.

When a Church is to be defended, the Doors must be covered with *Tambours* of thick Pallisadoes, joined or lined with Planks : The *Crenaux* must be 6 Feet high at least, that the Enemy may not reap any Advantage by them : The Earth of a little Ditch which surrounds it, serves to form the Banquet.

The Doors and Walls are also to be *Crenaux'd*, or, if the Walls be too thick, make them in the Windows ; this supposes a Scaffolding, which should run round the whole Building, to facilitate a Communication from one part to another.

If the Church be in form of a Crofs without, it in part flanks itself ; if not, the Vestry at least flanks one

one of the long Sides, and the *Tambour* should be so disposed as to produce the same Effect on the other.

There remains then only the Rear of the Choir, absolutely defenceless, this is remedied by piercing a second row of *Crenaux*, just low enough to discover the adjacent Parts before it; or else project from the Windows and the Roof (and as high as possible for fear of Fire) some little *Machicoulis's* of Wood.

If the Steeple does not afford the same Advantage as the Vestry, it may serve at least to see what passes at a Distance, and as a Redoubt to capitulate in, in case Assistance does not come in time: It was after this manner the Church of *Berg*, a Village in the Neighbourhood of *Lauterbourg*, was intrenched, during part of the War, terminated by the Treaty of *Radstat*.

III. Country Castles, and large well-built Houses are to be preferred to Churches, because greater Advantages are commonly reaped from them.

I shall continue to explain myself by what I have seen; this manner of instructing I am sensible flatters an Author, but it is best to make an impression on the memory, as we are commonly more attentive to the recital of a fact, than of simple Precepts.

The first Castle I had orders to reconnoitre was that of *Naterburg*, situated half a League from *Deckendorf* on the Side of the *Danube*.

Pl. IX. It was the ruin of a considerable Fortress for a private Man: it exactly possessed the summit of a very steep Hill, which was long and sloping, and almost every where of an equal breadth: The Buildings were in Ruins, but the surrounding Walls were solid and well preserved.

In the Plan annexed, no Flank can be seen in the surrounding Wall, because in my Passage thro' I discovered none, perhaps by not being able to penetrate into some Places encumbered and embarrassed by the falling of the Floors and Roofs; but the steepness

steepness of the Hill on three Sides, and the other, that is the Extremity of the *Esplanade* being of little Extent, and furnished with a Ditch, supplied this Defect.

One very material Circumstance was, that the Walls of the fore Court were about 15 Feet high, and those of the Castle more than 30, and were not *Crenaux'd*.

This little Fortress as may be seen, cannot be Attacked but on the Front of the *Esplanade*, which the first builders had in view, at least we may judge so, by the different Walls, which must be broke thro' or got over, on that Side, before it can be taken.

It will therefore be sufficient, to erect two Scaffolds, at the two Angles of the Rear of the Castle, so high as to discover what passes, over the surrounding Wall, and so disposed as to flank the three Sides if necessary.

In regard to the principal Walls of the Front, that is, those of the Castle, the *Fauss braye*, and the Fore Court, and also the Towers which flank them, they must have Banquets, Platforms, Crenaux, and Holes made in the most convenient Places, large enough to serve for Embrasures for some small Pieces of Cannon.

It is also absolutely necessary to repair the Breaches in the Wall of the *Esplanade*, with dry Stones, or to close them with Pallisadoes, to pallisade the bottom of the Ditch, to fraise the Parapet of Earth, and to render the Road impassable, when the Enemy approaches, by felling Trees, &c

This Post thus repaired and provided with Stores, with 3 or 400 Men for a Garrison, would be in a Condition to sustain a Siege.

IV. The first of *August* of the same Year 1742, I received Orders to fortify the Castle of *O*, a Country House situated between *Deckendorf* and *Regen*, from which it is about one League distant.

The

The Works I executed there were neither remarkable for their Singularity nor Expence, they were indeed trifling, but the Action which I shall mention presently, proves that these trifles were sufficient, and the detail may of be of some use to a young Engineer, or one who has had little, or no experience in this part of his duty.

Pl. X.

This Castle is built on the Summit of an Eminence, the Access to it, impracticable on one Side, and very difficult on two others : The Plan annexed, which must be attended to in reading the Sequel, will explain the rest.

My first Attention was to mask the Doors with Tambours of Firr Plank, and planted one against the other, elevated without from 8 to 10 Feet, just as I found it necessary to cover the adjacent heights, and *Crenaux'd* at every three Feet.

These Tambours, whose sides flanked where it was necessary, have a Banquet, and that of the great Gate, the only one not closed up, a Barrier of *Madricks Crenaux'd*.

The Rear Court and the Barn had no communication with their Tambours, but what were so low, as not to be discovered from without.

All the exterior openings, for 9 or 10 Feet from the Ground, were at the same time wall'd up, to guard against Fire, a common expedient of the Enemy; and as we did not want Planks, I ordered the Windows to be masked, for six Feet from the Floor, to cut *Crenaux's* in them, as also in the Doors.

Such were my general Precautions ; the top of the little Barn, and also the Walls of the great one were of good Masonry, and our Tambours defended this Front, pretty well, the only one easy of Access.

The Side next the River, was inclosed with high solid walls, and was not accessible but on the side opposite the Bridge ; and it was flanked by the Bog House, the Tower next to it, and the Tambour adjacent to the Tower : There was nothing to fear in the Rear, and

the Sides of the Brew House, were carefully built on a steep Rock.

From thence to the Pavillon, and from the Pavillon to the little Barn, the Wall was from six to seven Feet high, along which we flung up a Banquet: This Side being weaker than the rest, I ordered some *Crenaux's* to made in these Buildings: From the Brew House to the Pavillon, the Hill is very steep, but of an easier Ascent afterwards: The Garden on the outside was enclosed by Planks nailed to Posts; I ordered it to be pulled down, and also a dry Stone Wall three Feet high, which parted the Terrasses, and which would have served the Enemy for a Parapet by kneeling on the Ground: These two Terrasses I ordered to be made into a Glacis, and every thing to be cut down that might obstruct our View.

The little Barn, with which I shall finish the Description of the (*a*) *Enceinte*, was certainly the most dangerous Place, because three of its Sides were of Wood, and I was afraid that if the Enemy set Fire to this, it might communicate to the great one, which was much higher, but covered with Shingle, or cleft Wood.

In my Report, I proposed to pull it down, and inclose that space with a Tambour of the same Construction as the rest, and turned so as to flank the adjacent Parts; I should have done it of my own accord, but the design being to make this a Magazine of Forage, we were obliged to preserve Places proper for it, hid from the Enemy, since we could not keep them at a proper Distance: I therefore supported a Parapet of well beaten Earth, by the Wall of the Garden, and where the slope would not permit that, I doubled it with a Brick Wall, built with Mortar.

If I have explained myself as clearly as I could wish, it will appear that the Side of the Garden was the

(*a*) Surrounding Wall.

the only Place that could be forced without Cannon; and if the Enemy had got over this Wall, which was almost intire, I will venture to say they could not advance much further.

By raising a new Tambour, on the Side of the Court, and opening some old Doors, I had a free and sure Communication thro' the Stables, from the Castle to the great Barn and its Tambour; it was possible to prolong this Communication even to the Brew House by a row of Pallisadoes, but that was an augmentation of Work; a Wall must also have been broke thro', which was not without its inconveniency, and the Brew House, high and solid built, was in a very good state to do without that Assistance.

All the Windows and Doors of the Buildings being shut up to a proper height, and *Crenaux'd*, it is sufficient to cast an Eye on the Plan, to be convinced that the most obstinate Enemy, could not keep their Ground in the Court, crossed by so many Fires.

V. A succinct Account of what passed a few Days after, will the better justify the Effect of these Precautions.

The 9th of the same Month, in the afternoon, this Castle was invested by about 800 Men, from the Garrison of *Passau*, and the Camp of *M de Kevenbullen*, among them were 400 Grenadiers, some Pandours and Hussars.

M. Darmeville Captain Commandant of a Battalion of *Picardie*, held this Post with 50 Men, the Independent Company of *Regen*, and 80 Dragoons of that of *Jacob*, who being Prisoners of War were of no service: The French Commandant was oftentimes summoned to surrender on honourable Conditions; there also come an Hostage to him, that he might send and reconnoitre the Number and kind of Troops by which he was Invested. *M. de Pousac* Captain in the Regiment of *Normandy*, and who was of the Detachment, was charged with this Commission: He found the 400 Grenadiers, behind

behind a Hill adjacent, but neither this nor the confusion of so many Horses in so small a Place, nor the fear of the Forage, scattered up and down the Court, could damp the Resolution of these Officers

The Sight of the Tambours which almost covered the Front, made that Side to the Enemy not very easy of Access; they therefore attempted the Attack opposite the Mill, which they burnt; their design was plainly, to climb up under Cover of the Brew House and slip along the surrounding Wall, but finding the slope so steep and the Pavillon *Crenaux'd*, they quickly turned to the weakest part, that is, towards the Garden, where they had but one of these obstacles to surmount. The Besieged without the least hurry, or confusion, never fired but in good time and by order of the Commanding Officer; they killed some Pandours, who supported by their small Arms attempted to set Fire to the little Barn in the Night, with Torches fixed at the Ends of long Poles. This ill success discouraged the rest; and finding they could neither set fire to the Building, nor disorder our Troops by their frequent Discharges, they retired at One in the Morning, to some Distance, to consider what method they should take, to succeed.

The thing was difficult without Cannon, and *M. Saxe*, who had taken the Command of the Army, the same Day of the Attack, had not given time to bring any. This General being informed of what had passed, ordered a general Forage, the next Day on the left, where he marched in Person: Under this pretence, he detached by different Roads, two Corps of Infantry and Dragoons, who disengaged this Post, and who certainly would either have taken, or destroyed the 800 Men who attacked it, if too much ardour had not prevented their strictly conforming to Orders, of not appearing, but all at once, to cut off their Retreat.

VI. If my Design was only to give my own Ideas, and treat of Works of this kind, which I have executed, perhaps I should have nothing more to add here; but as my View is quiet different, I shall finish this Chapter with some Observations chiefly drawn from an Author, who is the more clear on this Subject, as he had frequent opportunities of experiencing them.

1. *M. de Folard*, the only one who has wrote on this Subject, prefers Walls of Brick and even the thinnest of them, to those of Stone, because Cannon only makes holes in them; and in Stone, where it makes a Breach, the Splinters do great mischief.

2. He recommends carefully to guard against Fire, and consequently, if the Building is covered with Thatch or Boards, to pull down the Roof and burn it immediately, lest it assist the Enemy in annoying you; as to the Boards, they will always be of use.

3. He proposes to stop up the Door, especially if it be large, with a Tree or two, with all their Branches cut and sharpened at the Ends, which he says forms an excellent Barricade. This has certainly a good Effect, but I do not see, why he would rather have the Door open, as he afterwards mentions, than to *Crenaux* it: He says nothing of the Windows.

4. He would have the *Crenaux* below 3 or 4 Inches wide, and 7 $\frac{1}{2}$ or 8 Feet from the Ground, that the Enemy may not Fire thro' them, and about 2 or 3 Feet, distant from each other, that they may not get to the Roof, without being exposed; above all he recommends to pierce the Angles.

5. Besides these *Crenaux*, he proposes others below, under the Intervals of the upper ones, and only one Foot from the Ground, digging a Trench 6 Feet broad and 3 Feet deep, 2 $\frac{1}{2}$ Feet from the Wall within side. By this means you discover the Legs of the Assailants, which when near cannot be seen from the upper ones: This is an excellent Thought; I would only recommend

recommend that they be even with the Ground and not more than 6 Inches high: The Trench need not be deeper, because they may fire kneeling. The Banquets of the upper *Crenaux* must in this Case be Planks.

6. For fear the Enemy should gain the Roof which we here suppose tiled, it must be scaffolded, so as to be defended by some Holes made in it.

7. He advises to provide a Number of Stones, to throw down, especially at the Angles, where the Enemy will chuse to sap.

8. If for want of Men, or other means, you are obliged to quit the lower part, he recommends, to use all possible means to keep the Enemy out of it; therefore Holes must be made in the upper Floors, especially towards the Doors, to fire down thro': This *M. de Saxe* practised, when he defended himself a whole Night in a Country Inn, with 18 Men only, against a Detachment of 200 Dragoons and 600 Polish Horse, who could neither force nor take him, though Wounded.

9. When you can only possess one part of the upper Rooms, *M. de Folard* proposes, to break up the Floors of those you abandon in many Places, particularly before the Doors, a little more than their Breadth, so that this opening may serve as a Ditch; but I think it is good to have an Eye below lest the Enemy get thro' them by Ladders.

10. Lastly, if the Doors are slight, and if they attempt to break them with Hatchets, &c. he would have you retire to some Distance, and to keep firing at the Place from whence the Noise comes: It was thus practised in Italy at the Defence of the Casine or Castle of *Bouline*, remarkable for that Action*.

The Reader must doubtless perceive that the most part of these Rules, agree with the different

* *Vide Folard's Polybius*, Vol. V. Page 421.

Articles of this Chapter, and adding what I have said on each in particular, I believe little more can be desired on this Subject. I will yet join some Reflections on the Attack, an Object always to be had in View, when we are treating of the Defence.

Supposing the Post in Condition, and sufficiently provided with Troops, and that the Enemy have no Cannon, they are then reduced, as *M. de Folard* observes, either to scaling the Roof, undermining the Walls, or making a Breach with a Beam suspended between four Posts like a Ram; now it appears impossible to me, that any of these means can succeed, as long as Ammunition lasts, or the Defendants preserve their Senses.

When you are obliged to abandon the Ground Plot of the Building; there is nothing to fear, in my Opinion, but Fire and Smoak, things very difficult to guard against; it should therefore be defended as long as possible.

But if the Assailants have some Cannon of 6 or 8 Pound Ball, and these placed out of reach of Musket Shot, it does not seem prudent to contend so obstinately against a Fire you cannot answer, unless you know Assistance is at hand, or when ordered to defend it to the last Extremity.

In fine, it must be remembered to defend the Doors, as much as possible, to flank the Walls and to make the little *Machicoulis* of Wood, I mentioned, and to collect a Number of Stones; but being more apprehensive of Fire, than sapping, I would rather have a Magazine of Water.

CHAPTER THE FOURTH.

- I. Of Fortifying small Towns and other considerable Places. II. Advantages and Disadvantages in regard to the Disposition and Construction of the Houses. IV. Inconvenience of their great Extent. V. Means of correcting it in certain Cases. VI. Inconveniences almost always insurmountable. VII. Of Places to be intrenched for a Day of Battle. VIII. Communications to be established from a Post to a Bridge; first Example. IX. second Example.

I. **V**ARIOUS Circumstances, such as the Necessity of keeping an Enemy at a Distance, of preserving Communications, of securing from Surprise a Body of Troops in Winter Quarters, or Quarters of Refreshment, often oblige us to fortify larger Places than those already mentioned.

An Engineer must, in this Case, carefully examine the Situation of the Place, the Nature of its Environs, the Disposition and Construction of the Buildings, the Extent of their Circuit, what Troops it can contain, that is to say, what Number can be encamped or quartered in it, according to the Season.

He must examine at what Distance the nearest Woods are; if the Roads be good or bad; the number and kinds of Workmen and Tools, and the number of Carts and Beasts to draw them, on which he can depend; in fine, what Assistance he can procure in the Place itself, and what are near at hand.

These Attentions are all equally indispensable; a Village, and even Towns under so near command, such as *Donavert* and *Deckendorf*, are always very bad Posts. A Precipice at all times, and, except in great Frosts, a River with steep Banks, a Place that can be inundated, a deep Morass, a low Ground and full of Ditches, are always Advantages, if they are at a convenient Distance from any part of the Intrenchments: So much of the intended Work is thus lessened, and a very essential Point, gained; for on these Occasions we have seldom any other Workmen than those we get from the Troops designed to guard the Place, and their Number is commonly regulated by what it can contain.

When we entirely surround the Place with an Intrenchment, a single Ditch, if it is not deep and full of Water, is seldom sufficient to stop an Enemy: It is therefore useful and often necessary to pallisade and fraise; besides there must be Bridges and Barriers which require Wood, Carriages, Workmen and Tools.

II. How important soever such Assistance is, we are often obliged to do without it: We may in part supply it, by the Means I shall speak of in treating of the Construction.

There are Places so advantageously situated, that they seem intended to be Intrenched: Such are those on the Brow of a steep Hill, or which occupying the bend, or conflux of Rivers not fordable, are naturally inaccessible for the greatest part of their Extent.

On the contrary there are some, which on account of some Defects not to be remedied, ought absolutely to be rejected, as incapable of any Defence; such among others, are those which are commanded by adjacent Heights, from which we cannot cover the Parts liable to be attacked: This Maxim tho' truly evident in itself, yet regard must be had to Circumstances attending it: The Part commanded for Example

ample may be inaccessible, and on the Side exposed to the Attack, we may be covered by Houses; in that Case, we are not much less able to defend it, since some little Posts are sufficient in those Places, from whence you are commanded; they may be sheltered and secured from danger, and yet preserve their Communication by some adjacent Building.

It was thus I proposed to establish a Post in the Church-Yard of the Suburbs of *Deckendorf*, situated at the foot of a Hill almost perpendicular, but partly covered by the Church: The intent was only to contribute to the preservation of a Communication from the Suburbs to the Town, and from the Town to the *Danube*.

III. A Village situated in dry and even Ground, such as affords no Advantage, is seldom proper for the use we are speaking of.

What is here esteemed a great Defect, is generally speaking a Circumstance to be desired in fortified Places; but tho' the Rules of Fortification may hold good in both Cases, yet they are very different: In one we work at leisure and with all things necessary; in the other the time and means are limited.

There is a necessity therefore of drawing from the Situation, such Assistance, as may abridge the Work; It is, as I have shewn, of various kinds; the Disposition and Construction of the Buildings sometimes furnishes the same Advantage, as a good Situation.

When I arrived at *Donaustauf*, in September 1742, I found some Officers of two Battalions quartered there, employed in intrenching that Town. The Castle, from which no other Assistance could be expected for want of *Crenaux* and Scaffolding, covered part of it by its height: A Hill of great Extent and the contiguousness of the Houses, greatly shortened the Work. I was otherwise employed and had only one Engineer with me: I gave them my best Advice, and they succeeded so well, that in a few

Days, having received Advice that the Enemy seemed disposed to attack them, they found themselves, in a good Posture of Defence.

When the Houses, tho' separated from one another in many Places do not form a very long Figure, and as in large Towns, are built and covered so as not to fear Fire, we may benefit by them, for we need only *Crenaux* them, and in the Intervals throw up some Intrenchments that may flank each other, or be flanked by those Buildings which project pretty far; it was thus I proposed for one Part of the Suburbs of *Deckendorf*.

But if the Houses are of Wood, as in *Bavaria* and *Bohemia*, or of Earth and Thatched as in *Flanders*, they are only fit for Habitations, and are otherwise more dangerous than useful.

IV. The greatness of the Circuit, adds to this inconvenience, and in regard to Circumstances, sometimes forms an insurmountable one. I found myself in this Case at *Pilsting*, a Town situated on this Side the *Isere*, half a league from *Landau*. Its Position made it proposed to quarter some Troops there, and we were resolved on this, when we knew that the *Austrians* had taken Possession of it.

I was sent from the Army the 14th of *November*, that is two Days after the Surrender, and having received Orders to intrench the Town, I carefully examined it, and quickly discovered most of the Defects I have spoken of; it is not commanded on any side, its Environs are also cross cut with Ditches and Drains, and almost throughout Marshy: But the Winter approached, and is very long and severe in *Bavaria*, we could not therefore rely on these Advantages of Nature, that ceased on the first Frosts: Besides of 70 Houses which were in *Pilsting*, 7 only were of Masonry, and the rest of Wood.

We were almost under a necessity of intrenching it entirely, or at least to fortify its Bounds by such Works as we have spoken of, which was not even practicable.

This

This new Difficulty proceeded, from the Houses, being mostly separated from each other by Yards and Gardens; their Circumference, tho' they formed four different Streets, could not be reduced to less than 850 Fathoms.

I perceiv'd that this Place would only quarter one Battalion, which was neither sufficient to fortify it, nor defend it.

This Reason alone was unanswerable; but I should also have had great Difficulty to get as many Palli-fadoes as necessary; the *Rindal*, a little Wood, one League off, towards *Straubing*, being entirely cut down, we were obliged to fetch them farther off, and the few Horses and Oxen, which the *Austrians* had left, were not sufficient, especially with bad Carriages and worse Roads.

The Church-Yard was spacious, and enclosed with a good Wall, and its Communication easy, with three Houses of Stone, and two of Wood, which join'd it, the Enemy not being able to get thro' those of Wood soon enough, if they did set Fire to them, not to leave us sufficient Time, to support, or at least to barricade the Opening they should make; and as this particular Post, good only for a last Resort, decided nothing in our Favour, as we cou'd not make Use of it, without abandoning the Town, the Sick, the Stores, and the Baggage, I did not hesitate to conclude, that *Pilsting* was incapable of being entirely fortified.

V. There are Circumstances, which oblige us to sacrifice the Interests of private People, for the Publick good: There are also cruel Wars, where the necessity of the Reprisal forces in some Measure the Devastation, which it authorises; very terrible Circumstances, and which an Engineer, should never practise without particular Orders, and which he should very seldom demand.

It is plain I would speak of those Occasions, where we destroy the offensive parts, to preserve with much less

less Work, those we have occasion for. Had we been in this Case at *Pilsting*, and that Part of the Town most compact together had been sufficient for our Purpose, all would have been easy, at least very possible.

By levelling the Houses, which extended along the Roads of *Straubing* and *Deckendorf*, we shortened the Circuit, more than 200 Fathoms, that is, about a Fourth, and we lost very little Quarters.

That was a great deal, yet the Remainder, seemed too considerable a Work, for one Battallion, weak as they always are at the End of a Campaign, and pushed perhaps, by the unexpected March of the neighbouring Troops, to hasten the Intrenchment: I believe that on these Occasions, we may have Recourse to the Expedient I shall here propose.

Having determined the Figure of the *Enceinte*, in the most convenient Manner, raise at the Angles, Redouts in form of Bastions, whose Fire crossing in the Intervals, reciprocally graze the Faces of these little Works.

Pl. XI.

The Plan will explain my Design: Five Sides of the exterior Polygon are of 100 Fathoms each: They may be of 120, or even 130. The Perpendicular is one Twelfth of the Side; the Faces are 12 Fathoms, and the Flanks perpendicular to the Lines of Defence.

The sixth Front is near 150 Fathoms, but it is better defended, as the Faces are grazed by the Wall of the Church-Yard, and the two Parts of this Wall, the most projected, are also grazed by the Flanks of the adjacent Bastions.

This Figure is no more than a Polygon fortified after the common Method, excepting, that there are no Curtains. The *Redans* would have been of more Extent, than these Redoubts, which are instituted in their Room; I therefore save all the Curtains, that is to say, more than 420 Fathoms of Work; for reckoning 50 Fathoms for each Redoubt, the 720 Fathoms,

Fathoms, which we should have to make, are reduced to 300.

As to the Defence, 50 Men in each redoubt, as many in the Church-Yard, and the rest of the Battalion drawn up with the Grenadiers, in the properest Place to support where necessary, is sufficient.

I dont know that this Scheme, was ever executed, or even proposed : Yet it is so plain, that I cannot think it new ; whether it is, or is not, it may be useful in certain Cases.

Having given a Detail of its Advantages, it is but right to expose its Defects : In a Quarter not inclosed, such as this, the Soldiers may straggle in the Night, the Peasants may have dangerous Communications, and a resolute Body may push thro' the Intervals.

It is the Commandant, it is the Engineer, charged with this Construction, that should examine if they can do better, in regard to Time, and the Number of Workmen : In this manner a Post is quickly in a state of Defence, which according to the common Method, cannot be but with a vast Body of Men : This advantage is a real one ; besides, if we have Time, or should hasten a little more, nothing prevents our perfecting the Enclosure with a Parapet of Earth, or by Trees, or any other kind of Barricades.

VI. Whatever number or variety of Expedients Experience and Imagination may suggest, Places are sometimes found in a Plain, as at the Foot of Mountains, which we can turn to no Advantage.

The greatest Part of Villages are thus situated ; the Houses commonly extend along one or two Roads that run thro' them, the Rest is only Courts, Orchards and Gardens, enclosed with very bad Hedges, narrow Ditches, Walls of Mud, dry Stone, or Wood, which renders the Circuit exceeding great in proportion to the Number of Houses : Such is

Schleitel

Schleitel on this Side the *Loutre*, only composed of two Rows of Houses in right Lines, and separated from each other; and is at least as long as *Strasburg*, including the *Citadel*.

When Houses are built, or covered with combustible Matters, it is, as I have already said, another Inconvenience: I found them all united at *Bischofsmais*, a Village, three Quarters of a League this Side the Castle of O, and designed also for a Magazine of Forage. The Church-Yard, the ordinary Resort in like Cases, could not defend the Barns, because of its Distance; besides being narrow, and surrounded almost every where with Houses of Wood, which commanded it, I saw that the Enemy, had it in his Choice, either to Fire on, or burn those that defended it.

I examined the Village, according to my Orders; but I propos'd nothing for its Defence, because it appeared impossible to me, to do any thing: So that a Lieutenant and 30 Men which we left there, had nothing to think of, but the safety of himself and his Men.

During the Attack of the Castle, some Men having appear'd to reconnoitre it, he took the only Advantage to be taken, which was to retire into the Church, barricade its Avenues, and make *Crenaux's* and Scaffolding, the Use of which I had shewn him: Chance favoured his Precautions, and saved the Magazine; twenty Volunteers who were escorting a small Convoy of Bread, going to *M. de Graffin* on the Frontiers of *Bohemia*, finding the Roads stopped up, joined themselves to him; they had two Drummers with them, which the Officer made good Use of, for at the usual Hour of beating the Retreat, he ordered them to beat that of the Infantry and Dragoons at the same Time, and it was this Stratagem perhaps that made them postpone attacking this, 'till after the taking of the principal Post, which as I have shewn, could not be forced.

VII. Thus

VII. Thus we find the greatest Difficulties to be surmounted in fortifying small Towns and Villages, are the Disadvantages of a commanded Situation, of an Enceinte of great Extent, and the dangerous Construction of the Houses, which will not permit us to use them in the Defence.

We have hitherto supposed the most ordinary Cases, that is, a detached Post or Quarters, to be secured; but there are others, where the Necessity of doing something, obliges us to be regulated by other Maxims. Such for Example, is the Fortification of a Village intended to be of service in a Day of Battle: Whether it be advanced, or in the Line itself, or on one of the Wings, it signifies little, and it is often-times more useful than hurtful, that it be commanded, provided it be only in the Rear.

The Number of Troops to be employed in it, not depending on what the Place can quarter, the Inconvenience of its great Extent, and even of the combustible Materials employed in its Construction, disappear; as the principal Use of the Houses, is to hide any necessary Movements from the Enemy's Sight, we enclose all that may be hurtful, not regarding the Number of Workmen and Troops such Works require, knowing we cannot fail in either.

The most essential and particular Attentions in this Case, in my Opinion, are to have as large Flanks as possible, because there is not the Chicanerie and little Feints of a long Attack, but the Effort of a Column to be resisted; to lay open the Environs, by cutting down all Trees, Hedges, &c. within two Feet of the Ground, that the Artillery may have the greatest Effect possible, and this must not be neglected; to embarrass the Ground before it, and on its Flanks, that the Enemy may not advance without being broke; and to level all in the Rear, that we may return to the Post, with Force and in good Order, in Case we should be drove from it.

When

When the Village terminates the Line, the Intrenchment must be prolonged by a Return Gibbet-wise, and the exposed side incumbered, and embarrassed, to guard the better against the Enemy's flanking us.

A favourable Situation, especially if it just rises so as to command the Parts we would batter, is always a great Advantage: Many Circumstances, which in other Cases, are considerable Obstacles, are not here to be regarded, and vanish by the Means we have, of supplying their Defects.

This Article is more essential to an Engineer, than is commonly imagined: Few Battles have been fought, without such Posts, and that of *Fontenoy* is an Example of what Importance they may be.

VIII. When the Town or Village is near a River, and consequently there is, or must be a Bridge, we must not only fortify the Town, but carefully attend to the Security of that Interval, that so essential a Communication, as well for Succours, as a Retreat may not be cut off.

I was twice intrusted with this Charge in *Bavaria*; *M. de Balincour*, possessing the Risings which commanded the Openings of *Dingelfling* on this Side the *Isere*, and the Enemy Masters of *Landau* only 6 Days before, having abandoned it, I received Orders to put that Place into a State of Defence, as soon as possible.

It is situated on the Summit of a little Hill, extending itself a little down the Side: Two Gates, one below, another above, almost divide the Enceinte, or surrounding Wall, into two equal Parts: On the Right of the Entrance of that Side, next the River, the Wall is low, not more than two Feet broad, and almost every where joins the Houses; but it is not commanded, and the Ground on which it is built is so steep, as to be impracticable to pass it. I observed that the Floors of the Houses might serve for Banquets to the *Crenaux*, and that they were easily built

built of Wood in the Courts, Yards, &c. such like Places I found round the Wall.

On the Left, the Wall appeared in better Condition, except in one Part, where it was propped up, and consequently must be intrenched; it was between 4 and 5 Feet thick; a little Roof which covered the Wall in places where the Houses did not touch, was a protection from the rising Grounds, and there needed only some slight Repairs, and to break thro' some Houses, to have a Communication from one Gate to another: This side has a broad and deep Ditch with a steep Talus.

There were Tambours and folding Gates, with their Barriers at the two Gates. The Enceinte, speaking in general, had neither Towers, nor Flanks; but I found they might soon be made, and at little Expence, by a method I shall speak of in treating of the Construction; so that by this Assistance, indispensable against scaling and sapping, I flattered myself, I should in a few Days put the Body of the Place into such a State of Defence, as not to be forced without Cannon.

The Suburbs were almost of as great Extent as the Town, I would not avoid preserving them, as well for the Necessity of Quarters at that Season of the Year, as to inclose the Spot where a Bridge was to be built, in the Room of that the Enemy had burn'd. These Suburbs were commanded by a Rising very near, resembling a truncated Cone, on the Top of which was a large Chappel. I proposed to possess these Eminences by Redoubts, which should communicate with the Ditch of the Place, and to raise some others here and there in the Flats of the *Isere*, to be joined together by a little Parapet, surrounded by a Ditch full of Water. These Precautions were sufficient on this Side; on the other a simple Intrenchment, well pallisaded, would inclose the short Space between the steep Hill and the River. This is sufficient to explain what may be done on like Occasions; it

it was the Work of a very few Days, but I had not time even to begin it.

IX. While the greatest part of our Troops formed themselves into a Body on the other Side the *Isere*, M. Saxe driving all before him that attempted, by favour of the Defiles, to oppose him in his March, advanced on the other Side the *Danube*; it was therefore resolved to return to *Deckendorf*. M. le Comte de Aumel, commanding in Chief the Engineers, ordered me (when I least expected it) to join him; which I did the same Day, returning by *Straubing* to *Ober-Alteich*, the general Rendezvous, and from thence to *Pogen*, our particular Quarter.

Our little Army which we then called the Reserve, chearfully embarked the 2d of December on the *Danube*; (except the Cavalry who took the common Road) and tho' often closely pursued by the *Hussars*, who drew up in order within Pistol Shot of the River-side, arrived at *Deckendorf*, a little below the Ruins of the Bridge we had burnt three Months before, when we set out for *Bohemia*.

The Enemy surprized at our sudden Arrival, and by that Rout, abandoned the Place after some Discharges of Cannon, so that instead of being employed in second, at the Siege, according to my first Destination, I was to put this Place into the best Condition possible.

This would have been an easy Matter, was is not for the Heights which rather plunged into it, than commanded it: It was sufficient to repair the Banquets of the Body of the Place, to renew the Platforms in the Towers; and in Case of an Attack, when the Spot was once determined on, to raise on the right and left, from the principal Wall, to that of the *Fauſſe braye*, Intrenchments, with Pallisades joined and *Crenauxed*, and ready prepared, which would flank the Troops with a cross Fire, who should endeavour to force a Breach, and which we in the mean Time, would have intrenched and barricaded within.

As

As to the principal Suburbs, the Proximity of the Paung, and also of the Hill, otherwise so disadvantageous, the situation of the Church-Yard, the great Extent of the Court of the *Parson's House*, and the Inclosure of the Capucins, were very favourable Circumstances.

I was charged with the Town and the Plain, that is to say, to repair the Body of the Place, to intrench the Suburbs, and to preserve a Communication with the *Danube*. The Plan will save me a tedious detail; I shall therefore confine myself to some Notes on it, where it requires an Explanation. Pl. XII.

The Intrenchment A at the Head of the Suburbs was begun; it was covered by a Redoubt, which could not be taken without being Masters of two others, and it presented a much greater Fire on the Defile than could be opposed to it; tho' good against a Surprize, it would be difficult to be maintained in a general Attack, because of the Heights.

The Church-Yard B is a Terrass reveted, raised 18 Feet, and lined with a Parapet of good Masonry, with large *Crenaux*'s: The Church and two Rows of Pallifadoes, would have covered the Party possessed of it, from the Fire of the Hill, tho' almost perpendicular: The little Intrenchment C which flanks it, covered an old Bridge, and inclosed a considerable Number of Houses.

The Intrenchment D (proposed to supply this in Case the *Enceinte* was found too extensive, or the Troops too much dispersed in the different Posts) and that of F cover a Communication, open from the Place to the Paung, as well by the Gate of *Nider-Alteich*, as by the Postern E, which I did design to make, when repairing part of the Wall that was fallen down: Dams also were to be made, to fill the River to the summit of its Banks, that it might not be forded.

The Direction of the Works, which extend from the *Paung* to the *Danube*, shew that it is a Crown Work, without Curtains, where the left Redan of the Head of the Bridge, forms one Demi-bastion.

The Front was also to have been defended by Batteries placed the other Side of the *Danube*: The Fire of the Bastion on the right covers the Gate of *Straubing*, and the little Work at the Ovens served to keep the *Saiques* in Awe, which might endeavour to get up again.

Supposing *Deckendorf* in a Plain, it could not have been put into a state of Defence, and the Communications preserved, with fewer Works; but *Deckendorf* and that part of the Shore, were commanded; these heights ought then to be occupied, and so as not to be dislodged; but that was not only very difficult, but almost impossible in regard to Circumstances; yet we endeavoured it, because it was an indispensable Point.

M. le Comte d' Aumale, our Chief, traced three Redoubts marked in the Plan; they could not be better disposed; but these Posts necessarily required a Number of Troops to possess and support them, he did not think of the state Regiments are in, at the End of a long and laborious Campaign, and our Cantonment was to furnish the whole; but although the common time of Sicknes was passed, those that remained in Health, six Weeks afterwards, that is at the End of January, were hardly sufficient to guard the Colours, much less to maintain themselves in a Post so disadvantageously situated; on which account, and the hardness of the Earth, caused by an excessive Frost, we had only traced one part of the Works, and that part also, far from being perfected, was no more than begun.

These

These Examples, which join under the same general Head, the manner of benefiting by an old *Enceinte*, intrenching a Suburb, the Head of a Bridge, and preserving Communication, I think are proper to conclude this Subject; we there find, that however disagreeable it may be to an Engineer to work in Places where there are difficulties not to be surmounted by Art, he must endeavour, without being discouraged, to remedy the Evil, in part at least, when he cannot entirely remove it.

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C H A P-

CHAPTER THE FIFTH.

I. Of Intrenched Camps; their Use. II. Of their Position: III. Of the Encampment of Troops. IV. Intrenched Camp of Russenheim; first Scheme. V. Second Scheme, with Reflections. VI. Enquiry into the Interior of the first. VII. Third Scheme. VIII. Defects of the first and third. IX. Intrenched Camp of Spire.

I. WHEN a large Body of Troops are to be assembled together, for their further Security, we intrench their Camp.

The Greeks the Romans and most other Nations, seldom made any stay in one Place, without fortifying themselves in it. The Army being assembled formed themselves into a Square, or some other rectangular Figure of small circumference in regard to the Number; this Custom seems to have been practised, 'till the last Century; but that of encamping with as a great a Front as possible, being since introduced, cannot be but by Lines, and it is neither of these Lines, nor of these transitory Camps, that we shall treat here.

The Camps we are going to speak of, are of a much more modern Invention; I do not know even, if we are not obliged to *M. le Marechal de Vauban* for them. They were formed in his time under *Namur*, *Atb*, *Lauterbourg*, and *Dunkirk*; and this General, so good a Judge of this Matter, ventures to say in one of his most curious Works (*a*) that he wished they were beforehand made under all the Frontier Places.

The

(a) *Traite de la Defence des Places.*

The principal Objects he proposes by this, is to put it out of the Enemy's Power to besiege the Place, or at least to expose them to the danger of not succeeding.

If the use of these Camps was confined to that alone, it is only in a Treatise of Defence of Places, we should speak of them, and we should have little more to add on that Subject, than what that celebrated Engineer has quoted; but however essential in that Case, they are not less useful in others, which fall under that kind of War we are here treating of.

Lauterbourg, for Example, with regard to its Fortification, and above all to its Position with the Lines of the *Loutre*, ought rather to be considered as a Post, than an ordinary Place, and with that assistance, it becomes in some manner unattackable.

A Town, such as *Spire*, surrounded with a bad Wall, without a Rampart, is itself, incapable of supporting a Siege; but by this means, Intrenchments are sufficient to deter an Enemy from attacking it.

The Advantages of these Camps extend yet further: An Army never exposes its Flanks to a Body of Troops, without imminent Danger, when this Body by its Extent, becomes formidable; even simple Detachments do not make Excursions with Impunity, when we render their Passage, and above all their Retreat so dangerous.

Lauterbourg and *Spire*, can by this means, if necessary, cover the Country on this side the Rivers which run thro' them.

In fine, the use *M. Vauban* observes they may be applied to, viz. to erect Magazines in without Embarassment, to contain all kinds of Baggage, and the neighbouring Peasants with their Families and Cattle, being common to the defence of Places and the subject in Hand, it cannot be passed by unnoticed,

II. We have never yet made an Intrenched Camp, but under some Place, good or bad : It serves for a Retreat, or Support as necessity requires, and it moreover has all necessary succours at hand, a very essential Circumstance.

It is seldom that the Environs do not furnish some favourable situation : The antient intrenched Camp of *Dunkirk*, was situated in a Plain, and covered on one side by the Canal of *Bourbourg*, on the other by the Canal of *Moure*, and the Front defended by *Fort Louis*. That of *Lauterbourg*, inaccessible in the Rear, was on the side of a rising Ground, at the Foot of which the *Loutre*, dividing into two Branches, runs thro' a flat and marshy Meadow.

We do not every where find such convenient Places, but it is the Engineer's Business to seek for them, and to seize on all Advantages.

We must moreover observe, that these Intrenchments being much less extended, and constructed more at leisure, than Lines, they are made much stronger, are gazoned, pallisaded, and in fine much more time and care is spent in fortifying them; therefore by this means, there is scarce any Ground but what may be put into a good state of Defence: We must except those that are so commanded that a *Manoeuvre* cannot be made without being perceived, and where the Parapets on that Account do not afford sufficient Cover.

Low, marshy, unhealthful Places, and those also where there may be a scarcity of Water, ought equally to be rejected.

III. When the Ground permits, the Figure of the Camp should neither be triangular, nor long, but such, as that its Superficies may be the largest possible, in proportion to its Circumference.

The Circumference is regulated by the Number of Troops destined to occupy the Post, and the Number generally, by what the Place can contain.

In

In either Case, it is necessary to know what space must be allowed for the Encampment, and *Manoeuvres*, and this cannot be known without entering into some detail; as well because of the difference of the Number of Men in the Companies and Troops that compose the Battalions and Squadrons, as the variations common in this Case.

The Head of the Camp must be parallel to the Intrenchment, and if possible 50 Fathoms distant from it at least, that the Troops may not be distressed for Room, in performing their necessary Evolutions.

A Foot Soldier's Tent is 6 Feet Square, exclusive of the Boot: 7 Soldiers, or 5 Soldiers and one Serjeant, are allowed to a Tent: The first and last face the Front and Rear of the Camp, the rest are parallel to the Line.

A Company strong or weak, always encamps in File, and consequently has but one Tent in Front. The Files or Companies are backed two and two, leaving an Interval of a little Street for the Boots.

M. Bombelle, gives 6 Paces, or 3 Fathoms, in Front for the 2 Files of Tents. *M. Haricourt*, allows only 5 Paces, which is as little as possible, the little Street for the Boots being thus only 3 Feet.

Between every 2 Companies there is a great Street of 16 Paces, according to one of these Officers, and only 6 according to the other; a like Street separates the Grenadiers from the Battalion, whose Tents are not backed by any others.

The Front of a Battalion is thus equal to 90 Paces, or 45 Fathoms; because the Battalions consist of 9 Companies, instead of 17, when *M. Bombelle* wrote; which shews that in encamping, regard must be had to the Ground that the Troops take up when drawn up in Battle.

As to the Depth, *Bombelle* allows 32 Paces for 11 Tents and *Haricourt* 17 for 6, which is much the same,

since there is always one Pace between each, without regarding the Boot of the first and last.

From the last Tent of the Soldiers the rest are placed as follows, to the Kitchens is allowed 10 Paces; to the Drummers and Sutlers 20; to the Subalterns 35; to the Captains 45; and to the Field Officers 80.

A French Battalion therefore on its present Establishment takes up for its Camp 45 Fathoms in Front, and 48 Fathoms 3 Feet in Depth, reckoning from the Head of the Tents; nothing can be deducted from the first of these Dimensions; but in the Case we are speaking of, as the three Field Officers are commonly in Lodgings, the other Distances may be diminished; I do not see the least inconveniency to reduce the Depth to 30 Fathoms.

The Interval of one Battalion from another is commonly 10 Fathoms, and there cannot well be less.

The second Line is commonly 100, or 200 Fathoms from the first, unless in certain Cases, such as an intrenched Camp, where 40, or 50 Fathoms are sufficient.

The Cavalry are commonly placed in the second Line; each Troop, like the Infantry, has but one file of Tents, and like them, two Troops are backed to each other.

Seven Paces are allowed for two of these backed Files, including the little Street; three Paces from the Front of the Tents for the Pickets for the Horses, which Face the Tents, and 12 or 15 Paces from one Range of Piquets to another, that the Horses may have room enough.

The Camp of a Squadron of 4 Troops takes up 50 or 60 Paces in Front, and its Depth according to the Number of Men, allowing 7 Men to a Tent, and 7 Paces from the Pole of one Tent to the next, including also the Quarter Masters, for every Horse takes up 3 Feet in breadth.

At

At fifteen Paces from the Piquets are the Kitchens and Forges; at 25 the Sutlers; at 45 the Subalterns; at 65 the Captains, and 30 Paces farther the Field Officers.

There is no Interval between the Squadrons of the same Regiment. *M. Haricourt* allows 10 Paces from one Regiment to the next, 30 between the Brigades and 40 between the Cavalry and Infantry.

I do not mention the Bells of Arms, nor Standards, tho' it is from thence we commonly reckon the Head of the Line; nor the Quarter Guards and necessary Houses, because this detail is not essential to the Subject in Hand.

In fine, it is right to consult all these things with the Quarter Master General, or to take your Orders directly from the General.

IV. I said we never had an intrenched Camp but under Places, I should indeed have excepted the following Case.

The 11th of May 1734, I was sent from the Army at *Bruchal*, to *Russenbeim*, one League above *Phillippsbourg*. I there found the Brigades of *Gondrin* and *Brianty*, each of 4 Battalions, and the Regiment of Dragoons of *Languedoc*, all under the Command of *M. de Balincour*. This Place, intended to be made a Post, could not contain so many Troops: it was therefore necessary to fortify the Camp, which was extremely easy, as the situation was very favourable.

The Plan sufficiently shews this: The Ground we were to occupy was higher on the Flanks and Rear than its Environs. The Right was covered by a Quick Hedge and bounded, as well as the Village by the *Pfintz*, a little River with steep Banks, where another Arm and two Rivulets fall into it. I observed Grooves and a free-Stone Flooring at the Bridge, which answered to make an inundation.

Pl. XIII.

Inundation. Some *Batardaux* could therefore easily confine the Water and raise it 8, or 10 Feet from the Foot of the Village, to the Place they empty themselves into the River: The Meadows near the River were also low and marshy. On the left a Meadow commanded by the Hill separated it from the *Rbine*, and the Chappel being on higher Ground than the rest, steep, and covered with Briars and Bushes, served as a Citadel.

Having by this, only the Front to intrench, and no want of Workmen, I was resolved to spare no pains. In the Evening I stoped the Water, to make the Inundation, and soon after, making my report to *M. de Balincour*, his Thoughts agreeing pretty well with mine, he ordered me to trace out the new Camp the next Day, in every respect, as in my rough sketch.

The Fortification is very simple and plain; it is a kind of Horn-Work of 150 Fathoms Front, covered by a Half-Moon; the perpendicular is 20 Fathoms, and the Faces 40: The right Branch runs parallel to a Hedge which covered it, but the left, being of much greater Extent, is flanked by Returns at right Angles and the Chappel.

This Line need not be very thick, as the Crotchets only are exposed to Cannon, because there is no possibility that the Enemy will engage in this confined Place, where they are also flanked by a considerable Fire.

An Engineer always works with pleasure when he is thus seconded by Nature, but I was soon deprived of this Pleasure. I had scarce marked out the Camp, when *M. Portal* who commanded us, arrived. He in general approved of my scheme; he would only have the Head of the Bridge secured by two Redoubts, and three Redans to the Demi-bastions and Half-Moon: Perhaps he had at that time designed the Bastioned Lines which we soon after traced before *Philipbourg*; however he delivered the Work

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over to another Engineer, and took me the next Day to the Lines on the *Loutre*, where I was in Chief.

V. I do not know how this Post was fortified, as I did not see it afterwards, but confining myself to the Figure, it was very difficult in other respects to conform to what was ordered.

We shall find in the following Chapter, that Redans in themselves, have some essential defects, by the obliquity of their defences. These defects, tho' known, do not prevent us from using them to cover right Lines and reentrant Angles; as to Salients when they are right, or acute, as the inconveniency increases in proportion to their acuteness, I do not know if we have yet found out the secret of using them there.

We commonly use small Bastions, and in the Case we are speaking of, as it is impossible to make Demi-Redans, we substitute Demi-Bastions.

From the Point of one Redan to the next is 120 Fathoms, and the Front was only 150. It was therefore necessary, in conformity to custom, to return nearly to my scheme.

A Redan may be placed instead of the Half-Moon, tracing the Ditch parallel to the Master Line, to diminish the length of the Faces of the Half-Bastions, which on account of the great Extent of the Front, I had left larger, to draw the Fires nearer, and to change the direction of the Flanks; but with all these Alterations, they are nevertheless Demi-Bastions.

I here suppose that 10 Fathoms, reduced to 8 or 9 by the thickness of the Parapet, is sufficient to flank a Redan; for the principal difficulty, after all, only exists in the small Extent of the Front. We could not extend it to the *Rhine*, in a right Line, without being commanded, in the Meadow, from the Hill, but it may be prolonged to the side of the Hill, which removes all Obstacles. The Draught annexed shews this prolongation.

Pl. XIV. The Plan I have here given, supposes this Prolongation. This manner is very simple, and perhaps new, to do without Bastions on the Angles, let them be ever so acute.

In fine, if Redans are sufficient to flank common Intrenchments, I doubt if they are so good to be used in an intrenched Camp, which is made to be defended with very unequal Forces, and having in proportion less Extent, ought when possible to be fortified with more care.

VI. I hope, it will not be thought I want to commend my first scheme, for tho' I think it better than the second, yet it wants a great deal to defend it from the judicious Critick.

I here remark the defects of both; the one, which is the subject of that Article, depends on the placing of the Line; the other, more essential, which regards the method of fortifying it, shall be treated of in one of the following Articles, and in Chapter 8.

I esteem it, as an established Rule, that the Head of the Camp, should if possible, be at least 50 Fathoms from the interior part of the Intrenchment, and in the Plan we are speaking of it is but 25.

The Camp of the Dragoons reduced to 69 Fathoms in Front for three Squadrons, is a little crowded, it is on the right opposite the Branch it must defend, and its Rear towards the Village.

But there being only 120 Fathoms from the Angle of the left Demi-Bastion to the *Rhine*, it may be asked, why is not the Front continued to the *Rhine*, since that Line, about two thirds shorter than that which runs towards the Chappel, would inclose more Ground?

To this I answer; my design was to have brought the Fortification more forward, by which means the Troops in that part, and in particular the Dragoons, would have had more room, but I was not Master; It was thought necessary to have as little Parapet to line,

line, as possible, and that it could not be done, but by crowding them together.

I doubt indeed if any of these defects, are of great importance. I know that an intrenched Camp as well as Lines, should have large Bodies of Troops, drawn up in Battle to defend them; that as the use of such a Work is durable, the Troops ought not to be incommoded in it; that sufficient room for Magazines of all kinds should be preserved. I don't deny any of these points, but we were not here confined to them.

This Post was properly only an intrenched Village, which could never be designed for a Magazine, and it was our Interest to keep it but a very little time; in short it was abandoned long before the End of the Siege of *Philippsbourg*.

As to the left Branch, I might add, that I preserved by that the command of the Ground; that, had the Front been extended to the *Rbine*, I should have run the risque of being plunged from the Hill, and this part of the Intrenchment tho' much shorter, required much more Work than the other; for besides the addition of an Half-Moon, it must have been constructed much stronger, to be able to resist Cannon. But I honestly declare that having only reconnoitred the Ground in general, that scheme as simple and natural as it may appear, did not strike me in the least.

VII. These replies, for the most part, appear rather excuses than reasons; which have occasioned a third Plan here annexed.

The Front is a Crown, traced after the common pl. xv. method, except the Flanks, which are perpendicular to the Lines of Defence. It does not run down the Hill, to avoid being plunged, but the Return of part of its Branch supplies that with little expence and without inconveniency, as it is flanked and covered by the rest.

The

The Head of the Camp, as in the others, is only 25 Fathoms from the intrenchment, because I believe it is sufficient here; the Cavalry placed as usual in the second Line, are 50 Fathoms from the Infantry, and have more room on their Flanks and Rear.

This new design, even reckoning the increase of the Half-Moon, has not at most so much Extent as the first; it is then preferable, as it incloses more Ground. Ten Battalions and 6 Squadrons have here more room, than Troops by a fourth less, have in the other.

As so considerable a Body of Troops, are capable of performing some extraordinary Enterprizes, and it is always material to shorten the time they lose in filing off as much as possible, I have placed a Gate in each Curtain, and one on the Left, near the Branch, which as it is less seen by the Enemy, may also be esteemed an Advantage.

VIII. This Plan, only given to shew how the inconveniences of the former may be avoided, is indeed exempt from them, yet all are defective in several material Places.

We cannot attend too much to the Flanks, since in them consists the principal defence: These are very large and well directed, but what advantage is reaped from them? For as there is only 5 or 6 Fathoms between the Master Line and the counterscarp for them to play upon, the rest of course fires on the Half-Moon.

This Half-Moon, necessary to cover the Barrier, is more hurtful than useful: It defends the access to the Faces I allow, and if we suppose a regular attack, it may be of service; but as we are here more exposed to a Storm than a Siege, and as in this Case it is very dangerous to stand your Ground in a detached Work, the best way will be to retire with your Troops, the moment of the Assault, to avoid confounding your own Troops with the Enemy, or seeing them rush in thro' the Barrier.

The

The Flanks having thus their full liberty, the besiegers will be exposed to a dreadful Fire, while in the Half-Moon.

These bastioned Fronts have one more inconvenience. The Ditch is so large, (in proportion to the rest) between the Half-Moon and the Curtain, that the Excavation becomes tedious, and Wheel-Barrows or Hand-Barrows must be employed to transport the Earth to the proper Places. To remedy that difficulty, I practised the following scheme in a parallel Case.

IX. In the Month of April, the following Year, Lieut. General Quadt ordered me to give a design for fortifying Spire, together with an intrenched Camp; the Situation was as favourable as we could wish it, between the Spirback and the Naiback.

The position, as to the Plan, is as good and more pl. XVI. opious than that of Russenheim; The Front I made about 500 Fathoms, and is of greater extent than the Ground by which it can be approached.

The Tower of Spire must be occupied to discover the motions of an Enemy quite to the Wood, but as a grand Guard only, that is, as a Post to be abandoned in Case of a general Attack.

A Ditch 30 Feet broad and about 9 or 10 Feet deep, runs at the Foot of this Tower; it was a great obstacle, especially for the Cavalry to get over under the Fire of Cannon. The Camp could not be brought nearer to it, without loosing the Advantage of the Ground in all respects.

The right Branch designed to make part of the lines, traced on the Side of the River, which I had before received Orders to reconnoitre, was to have been faced by an Inundation. Two Hills run along side of it; I followed the lowest, not to crowd the figure, and to be nearer the Water Side, it is higher than all before it by some Feet.

The

The Left extends along the *Neuback*, which in that Place was 15 Feet deep and 9 Fathoms broad, it can overflow the Meadow adjoining this Branch 4 or 5 Feet high.

The *Palatines* Tower is so near, that I thought it should be joined to the Line, as it commands an extensive Prospect, its Communication flanks all within reach, and covers one of the Dams necessary to overflow the Water.

In fine so favourable a Situation, as to the Plan, would be perfect in all respects, if all these advantages were not in some manner counterpoised by one essential defect; but as my design is to quote Examples and not give the History of Times and Places, a longer detail would be as foreign to my subject, as the explanation of the motives, we then had in View.

I supposed the attack in Front as at *Russenheim*, I resolved therefore to bastion it, but having more leisure to trace my scheme on Paper, I was more sensible of the inconveniency of removing so vast a quantity of Earth, and I immediately perceived that by making the Ditch paralell to the Work, there were Parts under Cover.

This Circumstance did not discourage me; I therefore shortened this troublesome part of the Counter-scarp in form of a *Glacis*, and that the fire of the flanks might have the more effect, I placed the Passages of the Gate, at the extremity of the Faces of Half-Moons. The Plan will explain the rest; I thus corrected my bastioned Fronts in some measure, but I am sensible that I only remedied one part of their defects. We shall treat more satisfactorily on this method in Chapters 7 and 11.

CHAPTER THE SIXTH.

- I. *Different uses of Lines.*
- II. *Objections and Answers to those that cover an Army.*
- III. *On those which cover a Country.*
- IV. *On those which are designed, for a new System of Defensive War.*
- V. *Necessity of supporting the Extremity of these Lines, and how.*
- VI. *Of the Distance of Lines, from Heads of Camps.*
- VII. *Defects of common Lines.*
- VIII. *Means of correcting them.*

I. **L**INES, as to their use, may be divided into different Classes; the one proper to hinder Succours, or to curb the Enterprises of a large and active Garrison, during a Siege, concerns the Attack of Places only, and consequently does not belong to our Subject.

The other, of which very few Authors have wrote, regards an Army in the Field; to oppose an impenetrable Barrier to an Enemy, or in fine, to enclose a large Extent of Ground more effectually on the defensive.

As an Engineer, is seldom acquainted with the General's resolutions, even in this Case, and as he ought not to work without knowing what dependence is to be had on his Works, and is more exposed than any other to answer on this Subject, we will here examine what is commonly alledged for and against these different kinds of intrenchments.

II. It is quite agreeable to reason, to supply by Art, the natural defects of a Situation, which we are obliged to possess: An Army should therefore fortify their Camp, provided the Works are not of too great Extent, are well directed, and so dis-

posed, as not to constrain, or hinder any movement that may be necessary to be made.

These Circumstances which include the whole, leave not much room for objection, but the execution is not equally easy. When for Example we would keep on the defensive and avoid an Action, we must either find an inaccessible Camp, or a Post that cannot be flanked, and oppose an intrenched Front to the Enemy, carefully flanked throughout its Extent.

This I believe is all that can be done, and tho' it is opposite to one of the above Circumstances, it shall not prevent our quoting the Words of *M. de Feuquieres* which agrees with the Lines of the third kind. "An Army in the Lines, says he, cannot
" sally out but by Files, and consequently an Enemy
" may make as hazardous movements as they please
" without fearing the least inconveniency. Thus I
" conclude that an Army constrained in all their
" movements is always inferior to one which is at
" liberty to hazard the most imprudent *Manoeuvres*
" without fear of Punishment."

This Maxim is worthy of its Author, I have already declared that the application may be just; but, not being able to hurt an Enemy is only an inconveniency to which we may oppose the grand Motive *Necessity*, which according to our supposition obliges us to attempt every thing to avoid an Engagement. *M. de Feuquieres* is also so far from blaming this Practice, that he says, there are Examples of Batteries being raised, and even Trenches opened in form, to force an Enemy from their intrenchments thrown up for want of a good Situation; an Enterprise which in his own Words, "always
" supposes a great superiority in the Assailants, and
" even a necessity of coming to Action, which is
" always attended with a great loss of Men.

If we are not desirous of avoiding an Action; but only to ballance the Superiority of Numbers by Fortification, so that some detached Works, whose Quantity and Strength, determined by this Inequality and Situation, may be sufficient, it is plain we are sheltered from the preceding Objection; but have we nothing more to fear? "Nothing is so discouraging," says the ingenious * Author of the Preface to a new System of Fortification, "as to think one's self on the Defensive; because it is very natural to reason thus; I defend myself, consequently then I am in Danger, or rather I am the weakest; but a sensible Idea of Danger, and a Knowledge of one's own Weakness, disheartens the most brave."

This is true, speaking in general, and we see the Consequence that may be drawn from it, even in the Case we are now treating of; but is it always in a General's power, not to be on the Defensive? And so far from Fortification being a discouraging Testimony of our Weakness, should we not always regard it as a remedy to supply its Defects? "The Shovel and the Pick, says *M. de Folard*, speaking of this kind of War, are the Ressource of the Weakest, or of those that would not hazard an Action; they are the only Arms, by which they defend themselves, and the best to hinder the Effects of others."

III. Lines, of the second Kind, fall under the same Objections, and are even more exposed to Censure. Their principal design is to defend the Country they cover from Contributions; to have it in their Power to raise them; to preserve a Communication from one Place to another, without the Necessity of Escorts; and to render these Places not liable to be attacked, as long as they subsist.

M. de Feuquieres, who agrees to all these Advantages except the last, pretends that they are not real; or are counterbalanced by great Inconveniencies; he thus explains himself.

“ Experience, says he, has frequently convinced us, that these Lines do not hinder a Country from paying Contributions, since to establish this Contribution, there needs only an Opportunity of forcing them once, during the whole Course of a War; after which, tho’ the Troops that forced the Lines, will be obliged suddenly to retire, they will find the Contribution demanded, and in a Treaty of Peace, if made with any equality, they must be accountable for the Sum imposed, tho’ not raised; thus Lines are of no Use in guarding a Country from Contribution.

“ The second Reason, *viz.* that of establishing Contributions in an Enemy’s Country, does not hold good. It is not the Parties that fall from Lines; but those from fortified Places, that levy Contributions.

“ That of facilitating a Communication from one Place to another, continues he, is a little more apparent, for those who would go without Escort, under cover of these Lines; but if in the End, it is only for the Security of Convoys, then that Facility is only apparent; for if a Prince reckons what the Construction, and Maintainance of these Lines costs him, and the Quantity of Troops they require for their defence, I am thoroughly persuaded, that he would find these Troops more usefully employed in guarding Places, escorting Convoys, and with the Army, than in guarding these Lines.”

I have before observed that this Author says nothing of that essential Advantage, of preventing Places surrounded by these Intrenchments, from being invested.

Such an authority is without doubt respectable; but these Maxims seem to be advanced in a very general manner. There are lucky Situations, such among others, are those from *Bergues* to *Dunkirk*, and from the Mountain to *Lauterbourg*, which being care-

carefully fortified, even a small and resolute Body are in no fear of being forced; therefore these Lines do guard against Contributions.

They have also the Means of imposing Contributions; for it is not clear, why a party sallying from thence have not the same Priviledge in that respect, as others.

In fine, if as in the first Case, such Lines join to fortified Places, these Places become unattackable; and if, as in the other, they join to an enclosed Town, but little fortified, it cannot well be supported, but by such assistance. I agree that this can not be on the *Loutre* without a certain Number of Troops; but are they entirely lost there? No, since they cover all lower *Alsace*, they keep in awe, and even distress a Body of Troops, at least equal to them, unless the Enemy abandon all the Country before them.

The Lines from *Bergues* to *Dunkirk*, have yet this Advantage, that even in the Presence of an Enemy, the Garrisons of these Places, and the adjacent Posts, may be sufficient to guard, or at least to defend them.

Will not every one agree, that it is much better to do without an Escort, than be obliged to take one, were it for no other reason but that they may be beaten?

To all these Objections, *M. de Feuquieres* has added, that of the Expence, which he says, exceeds what the Contribution will come to: This can but very seldom be true; but besides other Advantages which may be drawn from them, we must add, that of depriving the Enemy of that Contribution, which they otherwise could make, either in Money, Subsistence, or Labour.

IV. The kind of Lines, *M. de Feuquieres* most briskly attacks are those, which according to him, have of late Years established a new System of defensive War. "Experience, says he, has shewn the Falsity of this System, which consists in two incontestable Points."

The first is that we have spoken of, on Armies enclosed and constrained in Intrenchments. "An

" Army (adds he) in Lines, is never compact, because
 " it must defend a great Front, and consequently
 " when surprized in one Part, either thro' the Con-
 " stitution of the Country, or the Night, which may
 " conceal the Enemy's March, it is certain this Attack
 " can only be supported by one part of the Army;
 " for the rest cannot march to their assistance, but
 " with great Difficulty and in Column, which is
 " dangerous; besides, the part attacked will not pro-
 " bably be the Place where the Enemy design the real
 " Attack."

He afterwards remarks that these Lines being greatly extended, and constructed with the View already mentioned, must greatly weaken an Army to guard them; in consequence of which they have been forced every time they have been attacked; and besides, their excessive Extent preventing their being sufficiently furnished with Redans and other Works, they cannot be good; that is they cannot be fortified with sufficient Care.

I shall not take upon me to answer these Objections, so solid in themselves, while they only regard ordinary Cases; I agree that as to their Extent, simple Intrenchments of four or five Leagues, are not sufficiently fortified; but that an Army equal in Number are much exposed there; but supposing a favourable Situation, these Lines do not much differ from the second kind; we may therefore alledge in their Favour, what we have said of the others.

The Lines of the *Loutre* (a) for Example, are more than 5 Leagues long; yet if they were in the State they might be put in, with less than two Months Work, 20,000 Men could defend them with Success, against the most numerous Army.

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(a) These Lines are the same as those of *Viffembourg*, which *Feuquieres* mentions in his Remarks; I do not know that they have been either forced, or abandoned since 1706, when taking the Advantage of the Ground they were covered by Inundations.

It is true they have one of those Circumstances, which *Feuquieres* afterwards demands, *viz.* to reduce the Enemy to certain places of Attack, and it will be difficult, even to find any practicable; but they have but one, being very long, and supporting as well the only bad Place found in them, as they are also supported by it.

I believe then we may conclude, that as there is not any kind of Lines, to which we cannot make solid Objections, so there are none also from which we cannot draw great Advantages, when Art is seconded by Nature; I say seconded by Nature, for if they can be flanked and enfiladed, it is plain they are of no assistance. I am convinced, and shall always think, that Lines raised in dry, even and open Ground, such as a vast Plain, are much more dangerous than useful, as their Extent is much more than the Front the Army would occupy in Battle. As to intrenched Camps, we know that *Feuquieres* did not find the Attack so easy, which is equal to an Approbation; *Foland* and *Santa Cruz* speak of them, the first as a Practice of the Antients, which we have left off, for another much less advantageous, namely that of Grand Guards, Posts and Detachments in Front; the other as the best Means of easing the Troops; to be capable of making great Detachments; and not to engage but when it is thought to Advantage, and not when the Enemy please.

V. The chief attention in planning Lines, is, as was before observed, to support the Extremities so that they neither can, nor dare be flanked.

This Precaution is the more or less necessary, according to the Use these Lines are designed for: If they must cover a whole Country, as those of the *Loutre*, a vast and thick Forest, which is yet better for being marshy; a Chain of Mountains with narrow Passes, which are easy to be defended; a broad and deep River, or any such like Objects, are of great advantage.

These Advantages are absolutely necessary in this respect, for they are no guard against incursions without them, and such intrenchments, being mostly of a very great Extent, in proportion to the Number of Troops that guard them, they are almost only supported by the goodness of their Fortification: So that the Enemy have time to flank them, before that their defenders, much dispersed and very weak, have time to collect themselves to make them repent of such a movement, even when they shall be strong enough for such an Enterprize.

These Positions, favourable and yet indispensable, are scarce, I agree, but this kind of Lines ought also to be seldom used: As to those, which are only designed to cover an Army, which will not come to Action: but with that advantage, a fortified Place, a Town enclosed with Walls, a Country Castle, a little Wood which may be filled with Infantry, a Morass known to be impracticable, a River with deep Banks, or muddy, are sufficient: These may yet be supplied, as we have seen, by covering the Flank by an intrenchment, like a Crotchet, or by felling.

There are even Examples that a General not content with these precautions, has intrenched himself in the Rear, and thus shut himself up on all Sides, which forms a new kind of intrenched Camp, fortified according to the Nature of the Ground; but these Examples are scarce.

VI. If in tracing Lines we are obliged, at least in the principal Parts, to follow a Camp already fixed, which sometimes happens, or that some Village must be enclosed, which is much more rare, it is equally necessary for an Engineer to know what Space should be between the intrenchment and the Front of the Troops.

At *Philippsbourg*, for Lines of Circumvallation not differing materially from these, but in their circular Figure, what is agreeable to one, is so to the others;

at

at *Philippsbourg*, I say, this distance was fixed at about 65 Fathoms, and more was not left between the intrenchment and the Village of *Oberhausen*, although there were Troops encamped between them; but it must be observed, that this distance, is contracted as much as possible, to unite the Forces the better.

M. de Vauban, in his Treatise on Sieges, has fixed this distance at 100, or 120 Fathoms; this he afterwards extends from 60 to 120, in his Treatise on the attack of Places: It may be dangerous to give more or less, for in the first case, the Troops will be too far from what they are to defend; and in the second case, they will not have sufficient room to move in, and to leave a Passage in their Rear, for a Body of Troops to march wherever its assistance may be wanted, to support a part giving way, or too hard pressed: I believe then we determine this distance (unless in particular Cases) from 80 to 100 Fathoms.

As to the parts opposite the Villages, it is necessary, in my opinion, to add the depth of the Camp to this distance, if the depth does not exceed 60 or 80 Fathoms, counting from the Bells of Arms, or Standards, to the Subalterns Tents, or to the Kitchens at least, included.

VII. All Lines may be fortified in the same manner, not excepting those of Circumvallation and Countervallation, for they only differ from the rest in their use.

The common and almost universal Method is to flank them by Redans. In open Ground, for those of Circumvallation, *M. de Vauban* allows 120 Fathoms from the Point of one Redan to that of the next; 30 Fathoms for the Gorge, and 22 for the Capital; which makes the Faces nearly 27 Fathoms: It was nearly in this manner we traced those at *Kell* in 1733, and nine Years afterwards at *Nider-Alteich* in *Bavaria*.

Pl. XVII.
Fig. 1.

The

The flanked Angle of these little Works is 68 Degrees 34 Minutes, which is open enough, but, supposing the Lines of Fire to square on the Faces, as their Angle with the Curtain is 34 Degrees 17 Minutes, they pass more than 30 Fathoms before the middle of the Curtain, and do not cross the Capital of the opposite Redan but at 49 or 50 Fathoms from the Point.

It must be further observed, that supposing, as we generally do, the Range of a Musket 120 Fathoms, the collateral Fires, so far from crossing on the Capital, leave more than 7 Fathoms between the two nearest.

From hence then, reckoning the Range of Shot as before, and supposing also that the Soldier fires directly before him, each Curtain forms the Base of an *Isoceles* Triangle from 30 to 31 Fathoms perpendicular, which is not flanked, and before each Redan there is a space of 30 Fathoms broad, communicated to another of the same breadth, by a Passage of 11 or 12 Fathoms, which is not raked from any part; this will be better understood, by the Plan annexed: In fine, the Ditches have so oblique a Defence, that it is evidently of very little effect,

From the freedom with which I explain myself, I hope it will not be thought I attempt the Critick; it is a Title that would as ill become me as I detest it: I quote and examine with sincerity; let the judicious Reader decide: In one Word, my own Instruction and that of my Brother Officers, is, as I think I have already declared, the only Motive I propose in discussions of this Nature.

So far from entirely rejecting a Method adopted by so great a Master, and so universally received, I readily allow it is sufficient, if we suppose a large Train of Artillery; in effect, the most of these inconveniences disappear by this Means; Cannon commonly placed in the Redans, make its principal and almost only defence

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defence, and not firing at Random as small Arms do, the obliquity of the Faces, is not so great a defect.

We may yet alledge in favour of this method, that a Front of 120 Fathoms has only 144 of Parapet, that is, one fifth more; which is an advantage, especially when we are distressed for time, want Workmen, or have few Troops for the extent of the Parapet we ought to line: Yet these advantages do not ballance the defect of the oblique Fires; and Spaces not raked by any Fire which we are commonly obliged to have in most Field-Forts, should, speaking in general, be regarded as very essential defects, and even inexcusable in all Cases where they may be avoided.

VIII. After this Declaration, or rather Repetition, I think I may freely venture my own Thoughts: Experience has often convinced us, that a moderate Genius is sometimes capable of adding, and even perfecting the Discoveries of a great Man: If the Reader knew how thoroughly I was convinced of this Maxim, I should have no reason to fear being suspected of Presumption.

I have remarked four principal Defects in the common Method, and will here repeat them.

1st. The middle of the Curtain is not flanked, but at 30 Fathoms distance in Front.

2d. The direction of the nearest Fire does not cut the Capital, but at about 50 Fathoms from the flanked Angle.

3d. The Lines of defence being more than 120 Fathoms, the Fire which exceeds that distance may be esteemed as nothing.

4thly and lastly, the great obliquity of the Redan with the Curtain, hinders the Ditch from being defended.

I greatly mistake; or a very little Alteration will remedy the whole.

It is only to brisure the Curtain in the middle, so pl. XVII. that the salient Angle shall be on a Line with the Fig. 2. Points of the Redans, an Operation as plain, as easy in Practice.

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The Angle of the Face, with the Demi-Curtain, being only 98 Degrees 14 Minutes, the Parts reciprocally defend each other every where at a proper distance for a cross Fire, and the Ditches are also defended : the middle of a straight Curtain, which we never preferently attack, does not more collect all the Fires ; they are thus distributed more equally, and even trebled towards the Salients, which are the weakest parts.

I cannot here pass by one Reflection, so just and evident, that I regard it as a Maxim. The quantity of Fire that can be drawn from any Work, let us do all we can, is determined by the greatness of the Extent ; it is then only required to distribute it equally, or in proportion as the several Parts require, which I think is done here.

Let us see at what Rate we gain these Advantages. The Front supposed always of 120 Fathoms, has 154 of Parapet, that is 10 more than the common Method ; I ought also to remark, that the reentrant Angle will not be seen, whereas it was discovered, at least obliquely from part of the opposite Face. The Connoisseurs may judge of the Importance of this inconveniency, of which we shall speak more at large in Chapter 13.

C H A P.

CHAPTER THE SEVENTH.

- I. Of Lines, with Redans; new Schemes. II. with Tenailles. III. Another Scheme with Tenailles more perfect. IV. With Cremilleres. V. with Redans VI. With Tenailles, and Lunettes. VII. With Bifured Tenailles and Lunettes.

TH E alteration of the Fires of the Curtain beforementioned, produces another, very considerable, which is, that each Demi-Front, being sufficient for its defence, this becomes a Front entire; I will explain my self better.

The Front of a Fortification; speaking of the Defence, is a collection of Lines, turned so as reciprocally to flank each other; but, as according to the common method, the Curtain only fires right before it, and the two Faces which terminate it, are the only Parts, which have, or are designed to have, this property, the Front cannot be compleat, that is flanked throughout, if it is not composed of the Curtain and two Faces.

In the new Plan, if the Face defends the Demi-Curtain, it is also equally defended by it; so that supposing these Parts were detached from the rest, and that they cannot be attacked in the Rear, they will be capable of supporting themselves.

From thence, we may without inconvenience, give more distance from one Redan to another, but I would in this Case alter the Construction: From the middle of one to that of the next, I would allow 150 Fathoms, that is one fourth more, which in my opinion is the greatest length to be given: As to the Fire of the Faces, I would make the Capital of the Redan

Pl. XVII.
Fig. 3.

Redan (which also serves as a perpendicular to the Brisure) one fifth of the Front, and one Fathom more than half the Capital, for each Demi-Gorge.

This Fathom is to prevent the flanked Angle from being too acute; which without it, would be only 59 Degrees 22 Minutes; and now it becomes 63 Degrees 24 Minutes, that of the Face with the Curtain 99 Degrees 54 Minutes, and the length of the Face will be more than 28 Fathoms.

I think it must be confessed that this method is preferable to the old one, by the direction, and distribution of the Fires, and the shortness of the Lines of Defence, all Points equally essential. It does not much exceed it in respect to Work, since the extent of the Parapet, does not exceed the length of the Front, but by about 35 Fathoms, that is, only five Fathoms more than one fifth.

II. These Brisures remind me of the manner I traced an intrenchment of about half a League long, at the Camp under *Landaw*, in 1743: It was not the best I made in my life, but it is more generous to point out ones own faults than those of another; we need not fear being suspected of magnifying them, and one is less embarrassed for the turn and choice of expressions.

I was willing to follow, as much as I could the Side of a little Hill, about two Feet higher than the Meadow, and my Scheme was also to bring the River *Quiech* into the Ditch. It was on the Spot when I received my Orders, and it was to be traced out immediately.

It struck me to make it in form of plain *Tenailles*, or Swallow Tails, which appeared to me the best, having fewer salient Angles, and these Saliants very open, or obtuse, were in no danger of being washed away by the Water.

As to the Fortification, I knew very well that the Perpendiculars of two Lines, which formed a re-entrant Angle, crossed each other: I made no farther

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Reflection, and fixing each Front at 120 Fathoms, the Work was quickly picqueted out ; I forgot what allowed for the Perpendicular ; but we will suppose about one Fourth of the Front, and on this Supposition I will examine my Plan.

The salient and reentrant Angles by this were 126 Degrees 52 Minutes, consequently the Direction of the nearest Fire, supposed to square, forms an Angle of 36 Degrees 52 Minutes, with the Branch it should flank ; so that by this Obliquity there must be 4 Fathoms, where it does not touch the Capital, and even supposing it long enough, it would cut it at about 90 Fathoms from the Saliant.

I fall then into all the Faults I have found in the common Lines with Redans, (except that of the Curtain) without gaining any thing more than 10 Fathoms of Extent by the *Tenaille*, and being less liable to be hurt by the Current of the Water : For, giving 8 Fathoms more to the Perpendiculars, than what is allowed to the Capitals of the Redans, it is plain I was farther distant, at least in the Rentraints, from the Edge of the Hill I wanted to follow.

If we had not changed our Design, as to its Position, which hindered the Execution, I should not, I believe, have been the last to have perceived, that it would not have answered my Intent ; yet I should have discovered it too late. How came it about ? because I had not time to trace my Plan on Paper, to examine the Direction and Range of the Fires ; a confused Notion of the Rentraint deceived me ; I rejected the common Method, designing to give some Lines of better Effect, and I made them worse, or at least very indifferently.

The same Cause has often produced, and will often produce the same Effects. On these Occasions, we have seldom Leisure to draw out our Plans, which would be a great Advantage. A Number of Maxims, Examples, Analyses, &c. in this Science, would supply that Defect ; but how are they to be obtained ? We don't

don't study this Subject in fortified Places, because the Object is not before us, and there are no Books that treat of it. As to what we see in time of War Fatigue, different Applications, and various other Causes, often hinder our examining them so minutely as to profit by them: Besides, whatever Affinity there may be between Field Fortification and that of Places, the last is not sufficient clearly to explain what belongs to the former.

III. I experienced, as may be seen, what I have advanced; for if I had better known the Properties of the *Tenailles*, or had I time to examine them with my Compasses in my Hand, the Faults I have spoke of could not have escaped me; I should readily have found out from whence they proceeded, and perceived that to have remedied them, I need only have shortened the Front, and diminished the Opening of the Angles.

I employed both these Means in the second Plan. The Front is but 100 Fathoms, and the Perpendiculars far the third of the Front: The Line of Defence is under an Angle of 22 Degrees 38 Minutes, with the Branch it should flank, and it cuts the Capital at 41 Fathoms from the Salient, so that the Columns of Fire of each Front, after reciprocally crossing each other, cross also on a considerable Part of one of those Angles, with one of the Columns of the next Front.

The Extent of this Figure, as in common Lines, is only one Fifth more than the right Line or Front. I leave the Reader to compare the other Advantages of these Methods, and shall only add, that this Plan would much less have answered my Scheme of keeping close to the Side of the Hill, than that I designed, as the Length of the Perpendiculars would consequently have obliged me to retreat farther from it.

IV. Crotchets *en Cremaillere*, such as I made use of in the second intrenched Camp of *Ruffenheim*, may also form a new kind of Lines; we will examine their Construction.

Construction, and the Effect we may expect from them.

Divide the whole Front into Parts of 60 Fathoms each; let fall a Perpendicular from each of these Points, of one fourth of that Measure, that is, of 15 Fathoms; draw the Branch from the Foot of one Perpendicular to the Summit of the next; advance 5 Fathoms, on the Foot of the Branch, for the Crotchet that is to flank that Branch.

The Angle of the Crotchet with the Branch will only be 91 Degrees 21 Minutes, so that the Line of Defence will pass but 5 or 6 Fathoms from the adjacent flank'd Angle, and as that will only be near Half the Range of the Shot; it will cover the Angle of the next Branch opposite the Crotchet.

Thus there not being any Part that is not defended by two preceding Flanks, the Length of these Flanks, which is no more than 14 or 15 Fathoms, appear to me sufficient.

These Columns of Fire, following each other, and doubling towards the middle of their Range, have an unparalleled Effect, which is still greater, as it must be allowed, that when a distant Defence begins to weaken, it is good to procure a nearer.

We may also reckon among the Advantages of this Scheme, that the Salients, double in Number to the common Method, and flanked at Half Musket Shot, advancing very little into the Country, are less exposed to the Enemy; that on Account of these small Projections, and the Shortness of the Branches, it is easy to follow a determined Line, and to reap all advantages of the Configuration of the Ground; that it is the only Plan, in which a direct Fire runs parallel throughout and without Interruption, and also the only one, in which the Fires are equally distributed.

Tho' these Crotches may in this Manner be continued from one End of a Line to the other, I believe

it will be better, for the Reasons I shall give, to form a Salient of two Branches, equal to the others, at every 400 Fathoms, which Salient must be flanked by two Crotchetts, or Redans *en Cremaillere*, and that each extremity be terminated by a Bastion.

I would fix the middle of the Gorge of the Bastion, 20 Fathoms from the Point where the extremity of the Branch falls on the Line; its flanks I would elevate the same way, and of the same size as the Crotchetts of the Redans; then draw a Line from one Shoulder to the other, on the middle of which Line elevate a perpendicular equal to one of these Parts, and the extremity will be the Point of the flanked Angle, which thus will always be a right one.

The Advantage I here propose, is to draw from the flanks of the Bastion the same Fire from small Arms, as from the Crotchetts, and from the Face, where I propose Artillery, a Fire from Cannon, which crossing in Front, should serve as the first defence to the Line.

Besides, the Fires of the four adjacent Crotchetts cross before the middle of the 400 Fathoms, that is the part farthest from the Bastions, and consequently, from the Artillery, and has the most occasion for this assistance.

Altho' the Faces of these Bastions, are seen less obliquely from the Curtain, than those of the Redans of the common method, I allow they are the most defective parts; but besides their Batteries which render them respectable, if we would not make the Angle too acute, for fear of making them too long, we may render their access very difficult by Pallisadoes, felling, or by breaking the Ground in Holes, or Wells.

Supposing the Line entirely *en Cremaillere*, as we did in the beginning of this Article, the Extent of Parapet does not exceed a right Line, but by about 11 Fathoms 2 Feet in 60 Fathoms, which is not a fifth

fifth; but if we follow the Plan entirely, it will exceed between 84 and 85 Fathoms in the Front of 400.

I confess these Lines please me much, if only because the repetition of the Flanks, by their Proximity, double the defence, and render it more effectual. We must further observe, that the Artillery being, by its Position, out of the Line, it may if we please graze it, or very nearly; an Advantage which none of the methods have, that I have before spoken of.

There are Circumstances where we join enclosed Works to the Line, to favour the rallying of the Troops if needful. To effect this it is sufficient to detach the Bastions, and intrench them at the Gorge, but we must construct them by a strong Profile, and surround them with Pallisadoes, or Wells sunk in the Ground.

V. What *Folard* proposes in his excellent Commentaries on *Polybius*, may give a quite different Idea to the preceding Circumstances, as the intent of the Author was only to strengthen his Fortifications by an Augmentation of Works. "It must be observed, says he, above all things to make advanced Redoubts, or Arrows at every 30, or 40 Fathoms, and their Communications should be between 2 Banks, or Parapets, well pallisaded on all Sides, and so, that four Men may march a Breast, or in Front, between the two Banquets."

It could be wished that so learned an Author had entered into a greater Detail on this subject, or at least had given us a Plan of his Scheme; but as we must conclude, he supposes Lines with Redans, they must be after the common manner of tracing them; and from thence we may judge of the advantages and disadvantages of his Scheme.

We must then suppose a Lunette advanced 30 or 40 Fathoms before the Curtain of one of these Fronts; Fig. 1. for it is before the Curtain he places them: What is the consequence? that all, or nearly all the Fire of the adjacent Flanks, enfilades the Gorge, or fires direct

on the Faces. I here suppose that this Distance of 30 or 40 Fathoms, is taken from the Gorge, and not from the flanked Angle of the Work, or else, the Lunette, scarcely projecting beyond the Salients, would not have the intended use.

Pl. XX.
Fig. 2.

Without regard to the common Method, if Redans are so obtuse that the Lunettes may be defended and not battered, from whence are these Redans and the Curtain to be flanked?

It is not of the least consequence, in either of these Cases, that the whole Extent of the Communication shall batter the Faces of the collateral Redans; and if we place these Pieces on all the Fronts, the rest will fire on that which projects from the adjacent Communications. This Fire is without doubt as dangerous to yourself as to your Enemy; is not this a great Inconvenience? I know by experience, as many others do, that nothing is so perplexing as to find one's self thus exposed.

We may therefore, I believe, conclude, that these Lunettes, tho' good in themselves, cannot possibly be used with Lines traced after the common Method.

Permit me to make one digression; it shall be short, and the Example of the Author I quoted, authorises me. An Officer who can talk well of War, in general, if he is not an Engineer, has not the same force of argument, when he comes to touch on any part of Fortification; which equally confirms me in what I have before quoted; viz. that it is very dangerous to advance any thing on these subjects, that we have not proved, by Scale and Compass; and that it is only from the Corps of Engineers itself, that we must expect any instructions.

But to return to the Lunettes. I think all the effect we may expect from these Pieces, and especially from their Communications, so proper to command in Rear, may be obtained, by finding a Method of using them without any inconvenience.

VI. The

VI. The whole then consists in flanking their Faces, and directing these different Fires, so that they may not be hurtful to the other parts.

These Faces have no other protection to afford each other, than a Fire greatly advanced into the Country : They are at too great Distance from each other to obtain a grazing defence, therefore it is not from them we must expect what we seek for.

One Line only, whatever inclination we may give Pl. XX. it, cannot flank the Lunette and the intrenchment : Fig. 3 Were we not convinced of the Dangers and small effect of Defences badly directed or very oblique, we could not deny that the directions of these Fires are too scattering to part from one and the same Point.

Since then one Flank alone, will not suffice, let us endeavour to obtain two. Cut the Front (supposed of 120 Fathoms) into two equal Parts by a perpendicular ; give 35 Fathoms to the brisure of the Branches ; 18 to the Demi-Gorge of the Redan, and 25 to the Capital. Lay down the flanked Angle of the Lunette, 60 Fathoms from Intersection of the perpendicular with the front Line ; make its Faces 25 Fathoms, and draw them to a Point on the Branches of the intrenchment, 20 Fathoms from the extremity.

The Capital of the Lunette will thus be cut by the Line of Fire, at a little more than three Fathoms from the flanked Angle ; so that this Piece will be defended on each Side by 20 Fathoms, and the Branch of the intrenchment by 22 Fathoms, of a Fire almost grazing ; which is all that can be desired.

There remains only the Communication to trace ; and it certainly is not the most easy part. The Enemy cannot there be well discovered but in Front, by a part equal to its breadth ; Besides, if it is raised much, it is evident it will mask the Fire of the Branches, and if it is sunk, it will not command

enough, and be plunged into from the Ground without.

To guard as much as possible from these inconveniences, I give only 15 Feet for the Passage to the Gorge of the Lunette, and increase it to 30 at the flanked Angles of the Branches of the intrenchment.

By this obliquity, I hinder the Fire from grazing too near the Angles, and have the advantage of opposing an Enemy, when entered by the opposite extremity, with a Front more than double theirs; but as it is an Angle, and consequently cannot afford all the fire necessary, I would raise a Tambour, or Traverse *en Glacis*, at the beginning of the Communication, and make little Branches on each Side parallel to those of the Redan, as may be seen in the Plan.

As to the elevation, I would raise the Top 3 Feet only from the Ground, and sink the inside 16 inches, that is just as much as necessary to give the Parapet a proper height: The summit must be flat, without bent or slope, that the Fire may horizontally graze the Country.

Two different motives make me here reject Banquets; one is, that as we cannot give them less than four Feet in breadth, including the slope, the Communication would by this means be widened 8 Feet, and consequently more exposed to be taken in Rear; the other, that the less the Communication is covered, the more it will be plunged into from the Branches of the intrenchment.

It is impossible to hinder two Lines, parallel to each other, from battering one another; therefore one Communication always fires on the next, and I know no other remedy for it, but to place Lunettes at every other Front only. These Flanks would then cease to be hurtful to each other, and would protect the intermediate Front by a reverse Fire, which

which may be shortened some Fathoms, if we would have it better defended.

VII. This kind of Lines, is complicated enough, yet when we have more time than necessary for the essential dispositions, and the Troops are not fatigued with service, it may be prudence in a General to seek means of prolonging their employment ; besides the real use he would draw from this for the security of the Camp, it is well known, that it is the most agreeable method of preventing Desertion, Sickness, and all kinds of Disorders, which Idleness exposes a Soldier to : So important a subject requires our most serious attention.

When these Schemes, speculative as they appear, shall be difficult to put in practice ; when they shall have faults equal to those of the common Method, or even more essential, it will be always useful to mention them, to give them their full Career, if I may be allowed the Expression, and to shew what variety a subject, hitherto treated in so plain and uniform a manner, is susceptible of.

I would therefore propose the Enlargement of the Work in view, tho' it were as considerable as it is otherwise.

The Figure being traced as before, excepting the Redan, which is here left out, draw a Line of Defence, from the flanked Angle of one of these Branches, to a Point on the other, 45 Fathoms from the Salient ; from a Point, twenty Fathoms on the Line of defence, let fall a Line which shall be perpendicular to the other Line, and it shall be the Flank ; this Point at 20 Fathoms also serves for the direction of the Faces of the Lunette.

This alteration is but trifling in itself, since it is no more than a brisure of 25 Fathoms Base, but it produces a very great one in respect to the Fires : According to the first Plan, those of the Branches cross all on the reentrant, they cover it entirely with a parallel Fire, and are crossed by that of the Redan ; but we are obliged to leave one space vacant, not to batter

Pl. XX.
Fig. 4.

Lunette : The Fires of the new Brisure, the one part cutting the Capital of the same Branch, and the other grazing the opposite Saliant, cross with the other defences.

We here employ all that Space, which for fear of firing on the Lunette, we were obliged to leave vacant in the first Plan : This Circumstance, and that especially of the two additional Columns of Fire, which cover the Salients, should recommend this Plan, as well for using Lunettes, as for forming a plain intrenchment.

But this does not prevent us, even in the Case we are speaking of, from making a good use of the other. We should, as I observed, only place these advanced Works in every other Front, and the intermediate Front will be very well traced after this Plan. The large Columns of Fire which cover the reentrant, serve as a Lunette for the security of it; the Salients will be well defended, since being common to the adjacent Fronts, they will be crossed by four Columns of Fire.

We shall hereafter find, by the brisure *Tenaille*, and by the double and treble Flank, that this Branch of Military Architecture, is as capable of producing as strong Fortifications as that of Places.

CHAPTER THE EIGHTH.

I. Of bastioned Lines, after the common Method; their Defects. II. A new and more perfect Method. III. Scheme of Lines with detached Bastions. IV. With detached Works. V. Of Lines detached in parts. VI. Works to be made for a Day of Battle. VII. Example for their use at the Battle of Fontenoy. VIII. Of Lines joined to Works, closed at their Gorge.

TH E insufficiency of Redans for the Defence of a Line, happens, as we have shewn, from the great obliquity of their Faces: Supposing the Curtains straight, we cannot remedy this but by flanks, and to add flanks to these Pieces is absolutely making Bastions.

We gain by this additional Fire of the Flanks, for that of the Faces crossing in Front, serves instead of and exceeds that of the Redans; it is true, the Exent of the Figure produces this advantage in one respect, the rest depends on the Curtain, which is not weakened by it, as it is shortened in proportion.

This made me resolve to bastion the intrenched Camp at Ruffenheim, and afterwards that of Spire. I should have ventured this Novelty with much more assurance, had I known myself supported by such an authority as the Marquis de Santa Cruz, but his Book had not then appeared in France. "To flank an Intrenchment, says he, speaking of that of an Army, I would not confine myself to salient Angles, whose defences, are obtained under very obtuse Angles, by which the Defendants are greatly embarrassed: But I would form Bastions.

This

This kind of Lines is without doubt better, and at the same time more beautiful than that with Redans, supposing however, that there is no other real beauty, than what is useful. We may then wonder that they were neglected, even to appear unknown, before the Siege of *Philippsbourg*; they were the first and only of that kind that I had seen.

Pl. XXI.
Fig. I.

I traced one part of them which had 130 Fathom Front, 25 perpendicular, and 35 for the Faces; the flanks were perpendicular to the Lines of Defence.

Being acquainted only with these, I shall give no others for Examples, and as my subject has obliged me rigorously to examine the common Construction of Redans, I cannot, for the same reason, dispense of doing the same here.

The common Construction is such, that the Curtain is covered by so much Fire, as to become in some manner inaccessible: This apparent advantage is no defect in itself, but it necessarily produces one. The Fire a Front can furnish, being always proportionable to its Extent, if we direct too much towards one part, consequently another must want it: Our greatest care therefore should be to distribute it equally throughout, having regard to where there may be the greatest occasion of it; but that is not done here; the Curtain, the most reentrant part, of course the strongest in itself, reaps almost all this defence; and the parts most salient, and consequently the weakest, that is the Faces, have none at a distance from the Angles, and are not flanked, but very near, and for a small breadth.

I don't know that hitherto these Defects have been much regarded, perhaps they have been thought inevitable, as being nearly the same as those of common Lines; they do not appear less important than those we have already mentioned.

The first objection is, that the Ditch being parallel throughout to the Master Line, the Counterscarp must other hide one part, so that the Enemy in the Ditch cannot then be discovered from the opposite Flank. I have before mentioned this inconvenience.

The second, not quite so obvious, was made to me by *M. de Cormontaigne*, an Engineer of great abilities and reputation; it is, that the Enemy, masters of a Bastion, but yet too weak to march forward, will be dislodged, or driven back, with great difficulty; for having their flanks covered by those of the Work, they can only be attacked in Front, and by a Front in proportion to their's and the number of their Troops, than in a Redan; because of the smallness of the Redans and the great obliquity of their Faces. I will examine this observation with all the care and attention it deserves.

II. The greatest Defects of these Lines, being nearly of the same kind as those of the common Method, we may remedy them by almost the same means.

I always suppose the Front 120 Fathoms. Give Pl. XXI: much one fifth to the perpendicular; make the Faces Fig. 2. half the Lines of Defence; including their intersection and the flanked Angles; let fall the flanks square on this Line, and thus form a brisured Curtain.

The Figure suffices to shew that we thus gain two additional Columns of Fire on the Capitals, and that there is more left for the Curtain than it can want for its defence.

As to the cover which we find in part of the Ditch of the Faces, towards the Angle of the shoulder, I know, no other remedy than what I recommend for the entrenched Camp of *Spire*, and luckily that is sufficient. The hurtful part of the Counterscarp must therefore be taken away to about three Feet from the bottom; For Example, if the Ditch be seven Feet deep, the side is sloped for four Feet, in form of a *Glacis*, which must be so directed as to be grazed by a Line drawn from

from the summit of the Parapet, to the point where the slope begins.

The first difficulties being got over, I pass to the last. The Redan and the Bastion supposed closed at the Gorge, reckoning from the Master Line, the first contains 330 square Fathoms, and the Bastion 1770 $\frac{1}{2}$: One of the Gorges is 30 Fathoms wide and the other 76 $\frac{1}{2}$.

Therefore to attack the Enemy with equal advantage, we must occupy a Front more than five times larger before the Bastion than before the Redan, in regard to the Number of Troops they can contain; but as we must only consider the Extent of their Front Rank, this is reduced to little more than twice and a half.

Pl. XXII. Fig. 1. I think we may compare these Fronts in the following manner.

Form a rectangle triangle without, on the Gorge of the Work; on each of the small Sides, at their extremities joining the Hypotenuse, elevate a perpendicular 60 Fathoms long, from the middle of the Gorge, and with this Radius describe an Arc of a Circle, and the Fronts will be formed by Chords.

I suppose all the Fire contained in this part of the Circumference, because the obliquity of the Shot beyond these extremities would not sufficiently enter the Work.

We shall then find in the Redan five Fronts, which may be advantageously placed in that Space; one that is equal to the Gorge, two equal to the small sides of the Rectangle-triangle, and two others larger than these, and smaller than the first.

The Bastion affords but three, one equal to the Gorge, and two equal to the small Sides of the triangle.

Without Recourse to Calculations, as long as superfluous, it is evident by the Figure, that the Fronts which can be disposed against the Gorge of the Bastion, are not near double in length to the sum of

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the others ; for if we compare the Ares of the Circle, we shall find that one is more than 133 Fathoms, and the other only about 206. In fine, the Radii of these Arcs, that is, the distance from the Point from whence I suppose the Fire to come, the middle of the Gorge, will be between 71 and 72 Fathoms in the Redan, and 91 in the Bastion ; another disadvantage in this last Construction.

The Observation must then be acknowledged just, and if we come to close with the Enemy, it is easy to force them from the Redan, being drawn up in Form of a reversed Coin (*a*) ; but after all, the Gorge of the Bastion is but 77 Fathoms, and the total of the Fronts, which batter it at right Angles, is more than 184 ; therefore there is no Equality between the Assailants and Defendants ; and tho' I agree to this Inconveniency, I doubt if the Engineer who discovered it, thought it considerable enough to eject a Method, otherwise so disadvantageous.

III. In

(*a*) *Coin*, *Cuneus*, or *Embolon* of the Antients, is an order of battle celebrated in antient History. M. *Folard* (who is inclin'd to think that it is not a triangle but a Corps of a small Front and great depth) says, that the *Greeks* were not the inventors of it; the People of *Asia*, and particularly the *Jews*, knew it before them, it appears so in *Polybius*, *Thucydides*, *Xenophon*, *Arrian*, *Plutarch* &c. and in *Cæsar*, *Livy*, *Tacitus* and many others. According to *Tacitus*, the term *Cuneus*, does not always signify a triangular figure, but a *Cobort*; *Coborts*, he distinguishes from *Turma*, a squadron, thus, that *Cuneus* implies many Corps of Infantry, drawn up with a great depth; and that the *Cobort* commonly consisted of one. The *Greeks*, who have wrote on the Wars of the *Romans*, have inserted the Word *Embolon*, where the *Latinis* have us'd the Term *Coborts*, in the detail of the same Actions; and above all *Livy*, who has almost copied *Polybius* throughout, has often taken *Embolon* for a triangle, when by that Word, the Greek Historian, understood a *Cobort*.—Under the Emperor *Justinian*, his order of Battle chang'd its Name for that of *Caput porcinum*. At the Battle of *Leipsic* in 1631, where the *Imperialists* were totally defeated, *Gustavus* introduced the simple Coins between his Brigades of Infantry: This method subsisted after the Death of that great King; the *Swedes* us'd it at the Battle of *Oldenborp* in 1633, and at that of *Wite-Weyer* in 1642. However, the Figure convinces us that our Author means a triangular Figure.

III. In 1743, Necessity obliged me to invent a kind of Lines which I think good in certain Cases; that is to say, when we are to turn a small River, or fill the Ditch with Water. It was at the Camp under Landau. Mareschal de Noailles ordered me, when I was least prepared for it, to trace an Intrenchment from the Mill of Offenbach to below the Village of Offerheim; it was near 2400 Fathoms: The Work ordered to be begun by Break of Day, and it was then almost Night, and I half a League from the Place. The Word *Impossibility* should certainly be erased out of the *Soldier's Dictionary*; it is a mortifying Word to make use of: The Thing did not yet appear practicable to me. I therefore proposed to trace it in right Line, with some Salients at a Distance from each other, intending to flank it by some detached Works, when more at Leisure.

Pl. XXII.
Fig. 2.

An Engineer has great Reason to be satisfied with his Orders, when the General who gives them is himself an Engineer, and does not disdain to enter with him into the most minute Detail. I pointed out the Impossibility, which he was not ignorant of, and the Expedient which had struck in my Mind; he understood me with half a Word, and conceived even before I had explained myself, the Advantage of having a Parapet and a River before one, when we have not a Moment to lose in intrenching ourselves, and that the Works with Flanks that I proposed, furnished four Columns of Fire, instead of two, and being separated from the Intrenchment by a Ditch full of Water, if the Enemy took it, they were not much more advanced, since they could not keep there; and in fine that nothing was more advantageous, than to have Artillery placed in Works projected beyond the Line.

The Day was quite spent when I arrived at the Place, and the Fires I had lighted to shew the Lines were confounded with those of the Camp, and to add to my Misfortunes I had a Fever: I was there

ent before soon obliged to leave the Party ; but at 9 o'Clock
that the next Day the Line was traced : In short, being
worse than the Day before, I had great Occasion for
good an Assistant as *M. de S. Paul*, and was also
then much obliged to *Le Chevalier de Beausobre*, at present
Colonel of the *Hussars*.

This Work begun the same Day, was finished before I had traced the detached Pieces, because I was then otherwise employed : And as it was thought that nothing more was to be done than what appeared, drawing out this long Line without Flanks was ridiculed with some Appearance of Reason ; and the Motion of Prince *Charles of Lorrain*, having obliged us in the mean time to send a considerable Detachment towards the higher *Rhine*, and to retire with the rest of our Troops behind the *Moutre*, I doubt if this Piece of Work gained me any Credit with most Officers in the Army.

We find that Bastions here have not the Inconveniency I have spoken of in the preceding Article (for detached Lunettes with Flanks are in Effect detached Works) since the Enemy cannot keep there when he has done his utmost, that is, when he has forced the Line : But this Method is not good, when the ditch is not full of Water.

IV. I practised another occasional Method of forming our works, much more expeditious, at the same Camp, from *Queichem* to the Mill of *Offenback*.

This Method has the Advantage of the other, being practicable in dry or wet Ground, it consists in covering the Front of the Line with detached Works, so as reciprocally to defend each other, or more advantage which may afterwards be added in their Intervals.

When we are likely to be distressed for Time or Workmen, the Distance from the Middle of one of the Line's Works to that of the next may be 240 Fathoms. If attacked in this State, the Enemy cannot break

break thro' the Intervals, without first taking these Pieces, or being flanked.

If we have Time, the intermediate Pieces are constructed, and the Line is then defended in the same Manner as the Scheme before-mentioned for *Pilaging*, or what was practised in the Plain of *Deckendorf*.

We may also observe, that in this Case we are exempt from one of the great Defects of Lines in general, which is, that we cannot sally from them but by Files: But as it is necessary, especially when inferior in Number, to guard against these great Intervals, nothing prevents our closing the whole afterwards, by straight or brisured Curtains.

Great Care must be taken in tracing these Lines, Piece by Piece, lest we should batter the Work, which is to follow, instead of flanking it.

V. Those Lines which are formed of detached Works, tho' they may be esteemed as of this Kind are traced in a very different Manner. Such were those according to the History of *M de Turenne*, which were raised by General *Merci* in 1645, for the Battle of *Nordlingue*; each Piece was composed of a Redan plac'd in the Middle of two common Demi-Curtains whose Extremities were terminated by a Crotchet.

As I only quote this from the Plate, which had no Scale, I do not know what were the Proportions but changing the Figure a little, I would recommend the following Instruction.

Draw lines 100 Fathoms long, and 100 Fathom from each other. At the Middle of each Line tract a Redan of 30 Fathoms Gorge, and 24 Capital.

At the Extremities of these Lines, elevate Perpendiculares of 20 Fathoms, for the Brisures of the Branches; from the Foot of the Perpendicular to the Summit of that of the next Front, draw the Line of Defence, on which lay 6 Fathoms for the Direction of the Crotchet.

These Intervals are covered by 4 Columns cross'd Fire, on which Account I make them larger,

weak,

arger. The greatest Part of the Branches have 3, without reckoning the direct Fire; and the Faces of the Redans are flanked nearly at right Angles by the whole Length of the Branches; Advantages which the Intrenchments of General *Merci* had not, as the Demi-Curtains formed a right Line.

As to Cannon, they may be placed at the Angles of the Redans, or if we chuse only to use small Arms in these Works, we may place them in the Intervals, as General *Merci* did.

In fine, Intrenchments, detached in parts, may be fortified after many different Ways. All are good, in proportion as the Intervals are, and each particular part is, is more or less defended.

VI. This subject naturally leads me, to speak of another kind of Fortification, which does not differ much from this, tho' we cannot properly give it the Name of Lines. Excepting the last, whose use is more doubtful, all the Lines we have spoken of, either suppose, that we seek to avoid an Action, or are not willing to lose the Advantages gained by them; but their use in regard to Battles, is not confined to the defensive alone.

When a General more than equal in Forces, or resolved to risk an Engagement, advances to a Camp which he has reconnoitred, to stop an Enemy; or by drawing nearer to them, will oblige them by his Position to attack him; will not attempt to intrench his Camp at the Moment almost of the Action, and to begin Works which probably he would not have time to finish; he would not besides enclose himself, and put it equally out of his Power to attack, pursue, and reap all the Advantages of a Victory; but will seek to secure himself by those precautions, which often decide it; precautions easy, of little Work, and which in no manner obstruct the necessary Movements.

These precautions commonly consist, especially if weak, or the Cavalry, or Wings not sufficiently supported

supported, in securing the Flanks by Felling, or *Chevaux de Frise*, in deepening Ditches with upright Banks, in ruining Bridges, in destroying Fords, and in fine, to render them every where as inaccessible as possible.

When there are Villages, or some great Building towards their Extremities, they must be put into a state of Defence without loss of time; the same use is made of them when they are directly in the Line, esteeming them as fixed Points and Flanks. In fine, if we have leisure, large Redoubts are constructed, if not on all the Front, and so as their Fires may cross, at least in the weakest Places, or from whence the Artillery can be most advantageously served.

It is useless to add more, for as all depends on Circumstances, nothing positive can be said; and speaking in general would only be unnecessarily repeating what I have said in 7th Article of 4th Chapter.

XXIV. VII. I cannot give an Example of these Precautions, more known, or more convincing, than that of the Battle of *Fontenoy*: But as it is foreign to my subject to give a Detail of the Engagement, I shall confine myself to what concerns it, by the wise Dispositions of a General, who all *Europe* confesses, justified in the beginning of that War, what a celebrated Writer had predicted of him (*a*).

The Right of our Army being supported by *Antoin*, and consequently by the inundation of the *Schield*, it was necessary for greater security to intrench the Village, which was done in the Night, by the Troops that guarded it.

From

(*a*) *M. Folard*, speaking of the Method of firing which *M. Saxe* had introduced into his Regiment, "a Method (says he) that I admire, as much as its Inventor, whose Genius is one of the greatest Military one's I know; and we shall find in the first War that we are Engaged, that I am not mistaken in what I think". *Book II. Chapter 14th.*

From *Antoin* to *Fontenoy*, another Village intrenched with great care, and which was the Centre, was 800 Fathoms. This Front was covered by three Redoubts, the first on the Side of *Fontenoy*, the second 100 Fathoms from the first, and the third 140 Fathoms from the second, they were constructed, or rather roughly thrown up, the same Night. The want of time, in all appearance hindering their increase, the Fortification of the Centre was principally attended to, which was the most essential, because the rest was flanked by the Village of *Antoin*, which commanded almost all the breadth.

The left, squaring with the Front, extended to the Wood of *Barri*, joining to the Village of *Ramecroix*; he had felled the Wood at that Place, and posted the Regiment of *Graffin* in it, to observe what was there. It is plain we did not find this Wing so easy to support as the right; but the Wood, crowded as it is with Infantry, the felling which covered the edge and two Redoubts, which were raised, there applied this so well, that the Brigades which formed served in the heat of the Action as a reserve to the Centre. It is also clearly evident that without it, we could not have maintained ourselves in it, and have cut our army in two. I have nothing more to add on this Battle, but the fatigues of our Troops; for Works so imperfect, could not be supported against so vigorous an Attack, without great resolution. Yet all the Fire of the Village and the Redoubts, could not prevent the enemy from penetrating between both; a bold courageous

rageous attempt, and which seemed once to have given them the Victory, but which at length, by a prudent *Manoeuvre* on our Side, was turned in our favour of us.

VIII. The importance of these Articles, and their connection with the preceeding, will favour the digression in the last : but to return to our subject. It has for some time past, been strongly debated whether or not it be proper to join Works, closed at their Gorge, to Lines; it was formerly practised at least we may judge so by those of Circumvallation and Countervallation. Most Treatises of Fortification prove this, and not only Redoubts, but Star Squares with half Bastions, and other considerable Works. But *Coste* in his *W^ord* has written to the *Academy* that the Imperialists seem yet to use it being soon found them in 1734 at the Lines of *Etelinge*; as for us we have abandoned that; the last time we used that was I believe at the Lines of the *Fontaine* in 1704 whereto we erected some Redoubts in the most exposed Places, and chiefly to defend the Ditches and to put Batteries in such a way as to cover them. Now of all buildings At the same time perhaps we abandoned the Apartments for the Cavalry, whose use we shall speak hereafter y^t it is not only necessary to know what is practised, but what should be practised; that is, whether we have greater reason to suppose the one to neglect the other; for it is sometimes with these, as with the fashions, which many follow without Reflection, and for fear of being thought singular. *M^r de Vauban*, in his Memoirs on the conduct of Sieges, says, these Works were no more constructed, because they were found dangerous; but the only reason he alledges in his *Treatise of the Attack of Places*, written many Years after, is that of the Brevity of Sieges; thus he does not determine definitively, besides he only speaks of the Circumvallation and I shall not take upon me to decide this Point therefore what I shall say, must only be regarded as a suggestion.

as one single Opinion, which I am obliged to venture by the nature of my Subject.

There is no doubt, but this Method, well managed, might be useful in many respects. These Fig. 1. XXXII. Pieces elevated more than the rest, placed to advantage, by their Protection and Command of Ground, might defend the adjacent Parts; they are Asylums at small distances, under whose Fire, the Troops, drove back, or broke, may take breath and rally; it is also common in a brisk Attack well supported, to be forced to abandon a Battery, which when regained, and it is not without Example, the Enemy will have nailed up the Cannon or have been very careless; by this we are less exposed to such inconveniences.

According to the *Marquis Santa Cruz*, we gain another Advantage. He would have us regard an intrenchment, as divided into four parts, and each part given to the Command of a General, who should march with his Troops, to form in the place designed, if the Enemy force on that Side; and they cannot form with more Order and Tranquillity than under one of these Pieces.

Thus we have shewn their Advantages; on the contrary, if the Enemy once enter these Works, the loss of the Lines is almost certain, by the difficulty of dislodging them.

If this is the only inconvenience, as I believe it is, we may easily remedy it. These Works are of evident use, they must then be made; we have every thing to fear if the Enemy once take them, they must then be constructed with so much care, as to hinder their access and not expose ourselves to such Danger.

When I say they must be made, we must understand, that it is not distinctly on every occasion, but when we have time to put them into such a state, as not to be carried by Assault, and principally in Lines constructed at leisure, and designed to last a long time.

All

All kinds of Works are not proper in this case; we must above all avoid those which batter any part of the intrenchment; for in an Alarm in the Night, and often in the Day, the Soldiers mounting the Parapet, fire confusedly, on all Sides. The Star, an advantageous Piece, if within reach of another, ought for Example, to be avoided. The chief care in my Opinion, is to perfect the Works and cover the space between, as much as possible,

CHAPTER THE NINTH.

Of the Advantages to be drawn from a River, to cover Lines. II. What is to be done in flat Ground, when under Fire of the Intrenchment. III. When it is at a Distance from the whole, or any one Part. IV. Of Inundations; Case where they may be made by single Dams. V. Those made with Sluices; their Inconveniences. VI. A more perfect Scheme. VII. Scheme of an Inundation for Lines that are to stand a long time. VIII. Multiplicity of Dams; Means of correcting it. IX. Dams very long: Means of defending them. X. Recapitulation of all these Defects. XI. A new Method of forming Inundations in flat Ground, in any Place.

OF all the Assistance that we can expect from the natural Situation of the Ground for the Defence of Intrenchments of great Extent, such as Lines, there is not any more advantageous than a Body of Water, which is, or can be made, so deep as not to be forded.

This Assistance, so desirable, would naturally present itself, without any Necessity of improving it, whenever there shall be a large River in Front, was it not for one Circumstance, always joined to it, namely, that of being drained by an Enemy.

It is very rare to find these Advantages united: The Course of a River, such as we here suppose, is always of so great extent, that its impossible to line one of its Sides entirely; and whatever may be our Situation, or Extent, the Intrenchment will not hinder an Enemy from passing above, or below us.

These Rivers therefore, speaking in general, cannot serve for this Use, or rather they become in themselves almost impenetrable Barriers, by the Help of much less, and quite different Works, which we shall treat of in Chap 10.

Most small Rivers are preferable in this Case, to large ones, for they commonly rise in the Mountains, and running through a flat Ground for some Leagues, empty themselves into others much more considerable.

The great River and the Mountain, in this Case, serve to close and support the Extremities of the Line, and there is no more to do, than to render the Front difficult of Access, by the Assistance of the small one; which is executed after different Manners, according to Time, Places and other Circumstances.

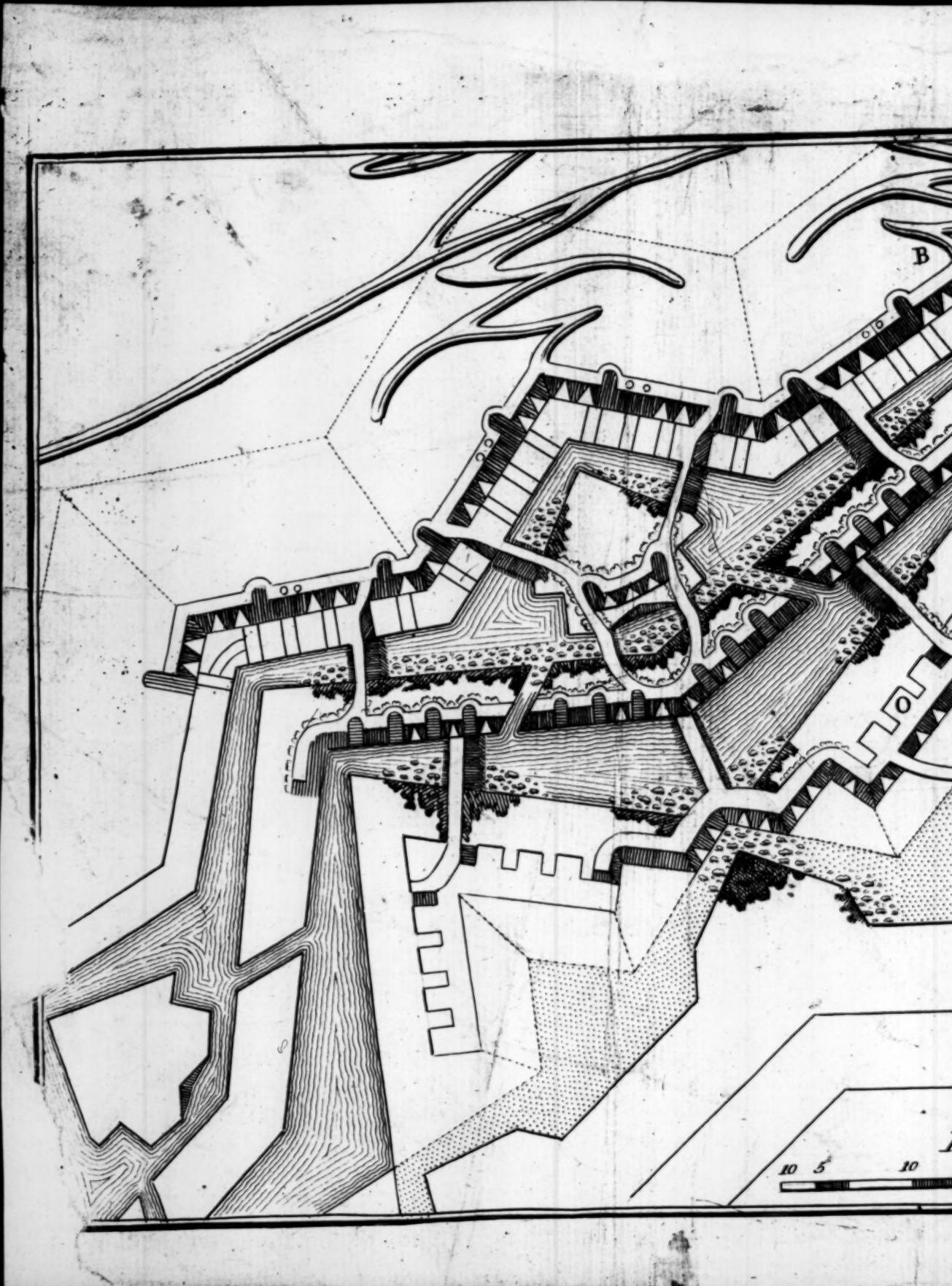
II. We have before observed, than when a Hill, or Eminence, runs parallel to the River, the Line must be traced on it, as well to have a Command, as that the Camp is more dry and wholesome, and the Communications are on firmer Ground, and better for Carriages.

When the Line thus traced is every where at a proper Distance from the River, that is from 80 to 100 Fathoms, it is a great Advantage, as the Paflage is defended by small Arms, without much Labour and Trouble.

If the Meadows between, are level and of a great Breadth, so that they cannot retain the Waters, or we want Time or Means to undertake a greater Work, we must be content to raise them within their own Banks, and keep up the Water at certain Spaces that it may not be forded: There are few that have not Banks 5 or 6 Feet deep, and that is sufficient; if they are steep, they are a greater Obstacle to the Enemy.

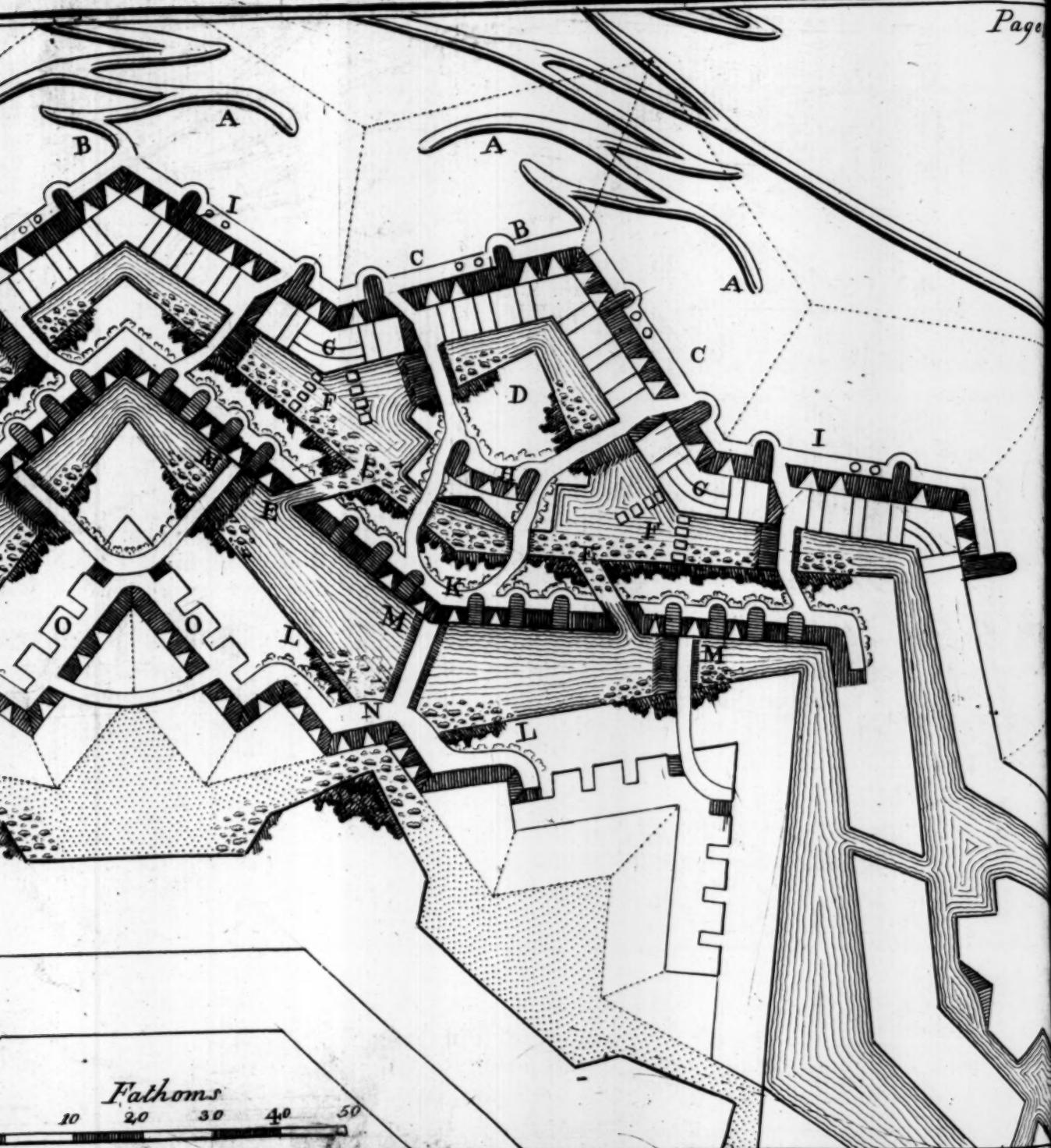
These Waters are commonly supported by Dams of Earth, which rising above the Banks, force the Water over the Meadows; these Retainers, the only ones I have seen, have a great Inconvenience, as they serve for Bridges to the Enemy. Those I invented at *Deckendorf*, and used in 1743 at the Camp of *Queich*, are exempt from this Defect; their particular Construction I reserve for another Treatise.

Their



Plate

Page



Their Number depends on the greater or lesser Fall of the River, and the Height of its Banks from the Water, for Example;

If this Fall be two Feet in 100 Fathoms, and the Depth of the Bank only five Feet; the Dams must of Course be repeated at every 25 Fathoms, in order to preserve four Feet and half of Water externally at the Foot of each; which is the proper Height or Depth, that it may not be forded.

But if this Fall be only six Inches, and the Banks 7 Feet, a Dam at 500 Fathoms Distance will produce the same Effect.

III. In the preceeding Article, I have supposed the whole Course of the River under the Fire of the Enemy; a very advantageous Circumstance, as the Enemy are thus prevented from throwing Bridges over it, or cutting the Dams; yet when the River runs 100 Fathoms from it, which I reckon a very proper Distance for small Arms, we may, by additional Works, draw as much or more Assistance.

If it runs off in an Elbow, and these Elbows or Pl. xxv. Curves are neither too open, nor too much sunk, Fig. 1. some advanced Works, joined to the Intrenchment and good Communications, will be sufficient to protect them.

If the Depth or Breadth of these Curves render Pl. xxv. at Expedient subject to Difficulties, a Canal must Fig. 2. be cut from one Extremity of the Curve to the other, a strait Line, observing to dam the old Bed, these Places, lest the Enemy should turn off the Water.

In fine, when the River is every where at too great a Distance, we are obliged to hollow a new Bed for it, if we would draw any other Advantages than the Nature of the Situation.

The Direction of this new Bed requires some essential Observations: If the Eminence on which we oppose the Intrenchment, is too high to carry the Water up, or the Side next the Meadow very steep,

the Canal may be cut from 15 to 20 Fathoms distant, or more, if that is not sufficient to command it throughout, throwing the Earth on both Sides, in Form of a Glacis, which increases the Depth. I say from 15 to 10 Fathom, because that Distance does not diminish the Effect of small Arms, and a Soldier, especially if he is not well disciplined, will be less confused, and fire more exact, than if the Enemy was nearer.

Where the Hill is steep, the Line should lie as close to the Edge as possible, and the Side scarped, to render it difficult to mount the Intrenchment; and where we are obliged to run off from the Side, it must be made in Form of a Glacis, so as to leave no Cover before it, which also furnishes Earth for its Construction; or else, at least in the first Case, we shall be obliged to dig a Ditch, which being very low in regard to the Summit of the Parapet, will be easily defended.

In the other Case, that is if the Intrenchment slopes gently down to the Meadows, and we bring the River there, we can do nothing better than turn it into a Ditch; it is then indispensable, as well to defend the Access to the Parapet, as to get the Earth of which it must be made.

The River, which must be dam'd, at the Place it quits and where it falls again into its old Course, being at least sufficient for a Reservoir to supply the two different Canals with Water, will also serve as double Barrier to the Intrenchment.

IV. When the River flows without much Rapidity, in a Valley, border'd by Hills, or when the Ground rises gradually to the right and left of the River, we are able to throw all before it, under Water.

These Inundations are made by Dams of Earth, which crossing the River and the lowest Part of the Ground, retain and elevate the Water; but as the Water carries away the Dam if it shou'd overflow,

care must be taken to make proper Outlets or Voiders.

Experience shews us, that Water flowing on natural Ground and shallow, does not hollow it, when it can extend itself.

In Consequence of this Observation, whenever the Valley slopes towards the River, we have Occasion for no other Discharger than the Ground itself beyond the Dam; but for greater Security the Ends must be hurdled and gazon'd.

Another Advantage results from this Work, for whether the Enemy cut the Dam, or turn off the Water by a Canal, they can only drain off one Part; because to drain it entirely, he must hollow and advance, as it runs off to the very lowest Part; which not being possible to be done in one Night, affords Time to discover and oppose them; besides, they cannot do it without being greatly expos'd to the Fire of the Intrenchment.

V. These natural Dischargers, save much Work, and do not require much Care in using them; but they are only to be us'd in such Places as I have mention'd. Where the Valley is level, or so narrow that we are oblig'd to run the Ends of the Dams home to the rising Grounds, or even from one Hill to another, it is evident we must have recourse to some other means.

In that Case we commonly use Sluices of Wood, which are constructed and placed according to the Use they are design'd for.

When we are oblig'd to use them as Dischargers, they are erected on the Meadow, and the Flooring fix'd on the Level of the Ground. The Advantage arising from this, is that there is no Excavation requir'd but for the Foundation, and these Sluices not being so deep as those placed in the River, require less Time and Wood for their Construction; they are also easier manag'd. The Advantages are attended with different Inconveniences; the River not being

able to pass over the Flooring, cannot have its natural Course, without cutting the Dams which stop it; which is necessary to be done, when the Enemy being at a Distance, or when at the End of the War, we wou'd drain the Inundation.

These Dischargers also require a continual Attention; for the Basons once full, the Vans must be rais'd to a certain Height to let a Quantity of Water pass, exactly equal to what enters; I say exactly equal, for if they are rais'd too high, the Inundation falls, and if the opposite extreme, it may perhaps blow up the Sluice and carry away the Dam also.

A few Hours Rain, or a sudden Thaw of Snow, considerably swells these Mountain Rivers; they must therefore be watch'd as well by Night, as by Day.

In fine, a Cannon Shot, or some Defect in the Wood, or their Construction, may disorder the whole in a Moment.

VI. The Count *d'Aumale* having order'd me, during the Campagne in 1743, to put the Lines of the *Loutre* in Condition, oblig'd me to seek some Method more simple, more sure, and less fatiguing to disengage from the superfluous Water some new Dams I wanted to raise, and also most Part of the old ones; for my Design was to dam those Sluices most expos'd to Cannon, and those that are made as low as the Bottom of the River, support a great Height of Water, which renders them less secure and difficult to manage.

I was resolv'd therefore to use Reservoirs of Wood, and the Flooring laid on the interior Side, three or four Feet from the Summit of the Dam, had according to this Scheme, a convenient Slope. Five Posts with Grooves, divided the Entrance into four equal Parts or Passages, making together 24 Feet opening, which is double the common Breadth of these Sluices, and may perhaps appear excessive, if I did not give my Reasons for so doing.

Water

Water passing thro' a Space double in Breadth to another, runs about half as high, which renders the Inequality of the Body less sensible; it is therefore much easier to keep the Inundation at a certain Height by Means of these Shutters.

Besides if one of the upper Sluices is carried away, or one of the Dams shou'd burst, all is in Danger, if the Dischargers are not large enough to give sufficient Room for this additional Water to rush out.

It is for that Reason I make the Floors of the Reservoirs so low; for in such an Emergency all the Shutters must be rais'd, tho' it does not appear necessary; for the upper Waters continually encreasing the Breach they have made, come down suddenly in greater Abundance.

These Reservoirs shou'd be made at a little Distance from the Line on the Meadow, and not in the River, as the Depth would render them less solid. As they have less Wood Work uncovered, and as the Shutters supply the Place of Vanns, they are more secure from Cannon than Sluices, to which I think them preferable, as well for the above Reason, as because being of a much lighter and less composed Construction, there is no more Time required for them, than what the Soldiers, or Pioneers employ to raise the Dam, so that all is finish'd at once.

VII. When these Lines are made to subsist all the War, or even in Peace, one would chuse that these Inundations may be made and fill'd on the first Order, that is to say, in the short Time necessary for filling or emptying their Basons, some little additional Work must be done.

Each Dam must in this Case have a Sluice, the Cill of which must be as low as the Bottom of the River, and the Floor large enough to let the Water pass at all Seasons.

The Course of the Water thus not being constrain-

ed, the Dams need never be cut to let out the Wa-

ter on any Emergency, when they are settled and well sodded; such in short as we need not fear.

This is the only Use I think we should make of these Sluices, as well for the Reasons already given, as the following.

First, Their Height being equal to the Depth of the River, it is often very difficult and sometimes impossible to raise, or lower the Vanns, according to the Depth of the Water, for these Vanns being very high, are greatly pressed against their Grooves, altho' supported by the lower Inundation. I here suppose the common Vanns, because they are subject to less Inconvenience, than those of a more complicated Construction.

Secondly, The Superficies of the Inundation must be regulated by the Shutters, and the River must fall entirely in a Cascade. It is easily conceived what the Floor must suffer, by the continual Pressure of such a Body of Water, as well by its Weight, as its Whirling, and the Mud which will be gathered there.

Thirdly, In fine, these Sluices are commonly founded in Clay; but as Liquids press in Proportion to their Depth, the least Filtration between the Earth and Floor, increasing every Moment, may blow it up. The Cill indeed is more secure, because of the dove-tail'd Piles, which should be drove before and behind it.

These Sluices serving only to retain and drain off the Water, and not to keep it at a determin'd Height, have no Occasion for Vanns. Two Rows of Piles, distanced from each other in Proportion to their Height, serve for, and form with the Checks, a Coffer, which is fill'd with Earth well ramm'd, or with Clay. This Batardeau secures the Front Piles, which it supports, and the Floor which it bears on; we have thus nothing to fear from Cannon.

As to the superfluous Water, it is discharg'd by such a Reservoir as I have mentioned.

I shall

I shall say nothing here of the different Ways, which according to Time and Means, we may turn the old Sluices of this Kind, into Reservoirs and Dischargers; because I reserve that Detail and the different Works which I here only hint at, for a particular Treatise on their Construction.

VIII. Having thus shewn my Opinion on the different Methods of covering Lines by Inundations, I will here remark the principal Difficulties attending them, and the Means I would recommend to surmount or avoid them.

The Construction of Dams is subject to two Inconveniences; their Multiplicity caus'd by the great Fall of the Ground, shall be the Subject of this Article.

These Dams made of Earth (for those I promised the Construction of, will be of no Use here) are, as I have already remark'd, as well Bridges for an Enemy, as consequently an Annoyance and Fatigue to an Army to guard them.

The only Remedy I know of for so essential a Defect, is to place them only at all those Places, otherways designed for Posts; because this decreases their Number, and to make them as high as possible with Prudence. If there are Sluices in the River, we shall find an Advantage, which perhaps does not present itself at first View.

Suppose the River five Feet deep; if the Cheeks of Pl. xxv. the Sluice are only rais'd 9 Feet, it is evident they will Fig. 3. throw but 4 Feet Water on the Meadow.

If there are four Sluices following each other, and distanced so that each supports these 4 Feet of Water, there remains two below the foremost Dam, which is the least that can be to hide the Bottom of the River and prevent its being fill'd up; I say that one Sluice only of 15 Feet high, will be of more Effect than those 4 of 9 Feet each, and which taken together are consequently more, by 21 Feet.

This

This Difference happens from the great Sluice being only once hid 5 Feet in the River, and throwing alone 10 Feet Water over the Meadow.

The little ones on the contrary being repeated four times, lose 20 Feet, which gives 15 Feet Difference. The 6 Feet remaining proceeds from this, that except the last, each of these Sluices only supporting 2 Feet more of Water, than that following it, there are three which lose 2 Feet each.

Another Advantage of the great Sluice is, that it throws 2 Feet more Water between the first and second small ones, 4 Feet more between the second and third, and 6 Feet more between the third and last.

Dams, Sluices, or Reservoirs raised on the Meadow have entirely this last Advantage; but it is not near the same with Respect to their Difference in Height, because of the 5 Feet, the Depth of the River, which is only once reckon'd; so that by the same Supposition, 10 Feet will produce the same Effect as 16. The Profile will explain what may appear Obscure in this Article.

The Thickness of these Dams, increasing in Proportion to their Height, certainly require a greater Quantity of Earth; but they diminish the Number of Sluices and, Reservoirs, and, what is more essential, there are fewer Bridges to guard.

If I suppose these Retainers of this Height, it is only to make this Proposition more intelligible; for being only necessary to have them of Timber and Clay, and not of Masonry, which is too solid for Field Work, it would not have them exceed 12 Feet: this will even be too much for Sluices with Vans; but to prove that those I propose are capable of that Resistance, it is sufficient to recollect that their Coffers make them real Dams, and tho' they are 12 Feet high from the Floor, they have not 12 Feet of Water to support, there being but 5 Feet Difference between the upper and lower Inundations.

For more Exactness, we suppose that when we overflow a Valley, we begin by closing the Sluice of the last Retainer first, and so on, as the Basons shall fall; without which the Height of the Water will effectually be 12 Feet at once.

IX. The excessive Lengths of the Dams, caused by the Distance of the Places proper to support their Extremities, form the second Inconvenience spoken of.

As the Protection of these Works is a very material Point, they must be rais'd in the narrowest part of the Valley, that their Heads may be defended by the Line, as much as possible.

As we are not always able to reap this Advantage; if it is farther Distant than from 60 to 80 Fathoms, it must be covered with a Lunette, capable of containing 100 Men at least, and turned so as to be flanked by the Fire of the Intrenchment.

But when this Distance exceeds 80 Fathoms, the best Way I think, is to raise a Redoubt on the Intrenchment it self, or flanks 30 or 40 Fathoms from the opposite Side, which shall cross the Dam: the opening next the Enemy must be covered by a Tamour, or turning Traverse. This must also have a Lunette, which only serving as an advanced Work, or other a Look-out, may be much smaller than the others.

A double Parapet raised on the Dam must secure the Communications of these different Works, at least from one Piece to another, if the Quantity of earth required should be too great.

This calls to my Mind, the Method taken to construct one of the Dams of the *Loutre*. It is an Intrenchment covered only on one Side, which by Returns, is secured from Ensilade, but yet opposes a crossed Fire, superior to what can be thrown on it from a Point of Land, stretching out from a Hill. This Work which does honour to the Engineer who erected it, shews what may be done on like Occasions.

X. The

X. The Difficulties found in covering Lines by Inundations, I think may be reduced to the three following Cases.

First, When the Ground thro' which the River runs, is on a Level for too great an Extent; for how can Water be raised on a Flat Surface, without Means of confining it? Yet this is not impossible; but I don't know that it was ever undertaken.

Secondly, When for the same Reason, the Dams are obliged to be made excessive long, for Want of nearer Ground to support their Heads, they require much Work, and Posts in Front; which being liable to be attacked at a time when Darkness renders the Defence drawn from those in the Rear weak and uncertain, are but bad Encouragement to Officers charged with these Parties.

Thirdly, Lastly, when the great Fall of the River renders it necessary to multiply the Dams, which (without reckoning the Increase of Workmanship) are so many Bridges to guard, and must of Course be carefully watched.

I have shewn what is commonly done in each of these Cases, but if I was charged with such an Undertaking, I would avoid these Obstacles, and go quite another Way to work.

This Expedient I think preferable to the common Method, for by it, I would undertake to render the Line inaccessible, without these Sluices, without these long Dams which are so troublesome, without these Posts, advanced and dangerous, and with a Quarter of the Expence.

This Scheme as plain as new, I contrived, by Order of the Court, in 1735, for the Lines of the *Spir* *back*. This River we have shewn, runs almost every where at a considerable Distance from the Hill, flows full to its Banks thro' flat Meadows, and is very broad. Necessity obliged me to seek a Remedy for all; in fine, I positively promised an Inundation commanded throughout by small Arms; but without

explaining the Method I propos'd to follow: This was perhaps esteemed a Chimera; be that as it will, I heard no more of it, and a little after, two Brigades of Engineers were detached from the Army, and charged with these Lines. I could not with Decency propose my Scheme, as they did not demand it of me, so that the Opportunities of executing it at the Camps of the *Loutre* and of the *Quech* in 1743, not taking Place, I never produced it, nor even committed it to writing; however the Publick may judge by the following, if it has any other Merit than its Novelty.

I suppose all the above Difficulties united, that is to say, the Valley quite level and of a great Breadth, which according to the common Method renders all impracticable, and the River flowing full to its Banks has only 4 Feet depth and 2 Feet fall in 100 Fathoms.

My Method leaving me at Liberty to prescribe what Breadth I please to the Inundation, I will examine what is the most advantageous; if it is narrow, it is not a sufficient Obstacle to an Enemy, if wide, it is badly defended, and the Dams extending in Proportion require more Work.

These Things considered, I determined its Breadth between 40 and 60 Fathoms.

Pl. xxvii.

I trace the Side 60 Fathoms from the Curtains and other principal Lines of the Intrenchment, observing in those Places where the Hill, and consequently the Fortification winds, to follow those only of a great Extent, and to contract the Breadth before the others, that is to say, to run out from 40 to 60 Fathoms, according to the greater or lesser Projections of these Parts; because the more it inclines to a right Line the less Extent it will have.

Six Feet within, trace a parallel Ditch from 15 to 20 Feet broad, and from 4 and a half to 6 Feet deep, just as the Water requires: The Earth dug up will form the Dam made lengthways to support the Inundation, preserving 6 Feet for a Berm, and this Dam

Dam is diminished so as to leave no Cover for the Enemy.

If I have not Wheelbarrows, I make another Ditch parallel to this at the Foot of the Intrenchment, which in this Case follows its Windings; if not, it must be contrived that the Scarp must be seen throughout from the Intrenchment.

The Bason being thus bound at every 2 Feet fall that is according to our Supposition, at every 100 Fathoms, trace the Retainers. These Retainers are made of Earth across the Meadow, and those in the Ditches are made of Wood; we shall presently see the Reason of this Difference.

The Dam on the Side begins at 3 Feet height and ends at 5; that which crosses the Meadow, supposing the Bason level, is raised every where to 5 Feet, tho' it sustains but 4 Feet Water in the deepest Place, which is sufficient to leave 2 Feet at the Foot of the upper Retainer; but this Foot is also necessary to prevent the Water from overflowing.

The Earth for the Dams of the Retainers is thrown up from a Ditch dug above, and also deep as those to which it communicates at the Extremities; leave 6 Feet Berm at least between the Foot of the Dam and the Scarp of the Ditch, whose Slope or Talus must be equal to its Height.

The Dam or Batardeau adjacent to the Side of the Inundation must be made so that it cannot be walked over; and as it cannot be wasted by the Water, it may be level with the Surface; it will also serve as a Reservoir in Case of need.

The other is of a different Construction; a single Vann in the middle, without any more Expence, will have the same Effect as a Sluice, which costs much more; this Vann being raised, will fill the Ditches, which communicate with each other, in a little Time, by closing the Vann, and throwing the River into its old Course, it will serve as a Reservoir; in fine, when one would form the Inundation, some Planks,

Planks, slipped into the Grooves, will support it to a determined Height.

The only Objection I know, that can be made to this Method, is the Loss of Water caused by Filtration thro' the lateral Dams, as they are very low and thick. This does not appear probable to me; but supposing this Filtration, it can be no Inconvenience, as we need never want a Supply of Water from the River. If we think the Vans not sufficient in this case, lower the wooden Batardeau some Inches to serve as a Reservoir, observing to keep them higher as we descend; it is of the greatest Consequence to secure the Entrance of the Water, for on that the whole depends.

This Method is equally good to cover Lines entirely by Inundations, as to correct the Defects of those already constructed after the common Method.

C H A P.

CHAPTER THE TENTH.

- I. Of Intrenchments to be made in Case of a River.
- II. Plans of Works to pass it by open Force.
- III. To pass it in Presence of an Enemy.
- IV. Another Scheme.
- V. Example of the Camp at Nordheim.
- VI. Precautions to be taken to prevent the Passage of Rivers.
- VII. Remarks on M. de Folard's Epaulements.
- VIII. Continuation of these Remarks, and Schemes of the Author.
- IX. Other Schemes of M. de Folard.

I. **T**HE various Operations a General may be obliged to undertake to pass or repass a River, or dispute the Passage with an Enemy, require the Construction of many different Works, which shall be the Subject of this Chapter. These Works are seldom of so great Extent, as to be ranked with Lines, yet as their Figure resembles them more than any other, I thought they could not be better placed than following Intrenchments covered by Rivers or Inundations.

I shall confine myself to the Works alone, and not touch in the least on the necessary Movements of the Troops, as I am resolved never to run from my Subject, or make any unnecessary Repetitions; for tho almost nothing has ever appeared on the kind of Fortification I have here undertaken, it is not so with the other Parts of this Science, on which so many Treatises have been published, that little more can be desired on that Subject; what I have quoted, and shall still quote, will be sufficient to convince us of this when those Writings are less known than they are present.

II. When a River must be passed by open Force whether it be done by natural Fords, or the Means we shall speak of have rendered it practicable, whether by Boats, on floats, or swimming, it is always absolutely necessary, that as soon as the first Troops have

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passed over, and begun to intrench themselves, we should procure convenient and sure Communications.

A Bridge therefore must be flung over; but when there is only one, a Fort such as we described in Chapter 2d. will not be sufficient, as not being large enough to contain the Troops that must pass; the first that arrive will be embarrassed in the Defence, or run the risk of being taken off from the Counterscarp.

Besides this Work, which will be sufficiently lined with eight Men or less to a Fathom, and where the rest of the Troops must file off, we must endeavour to find a Spot where they can intrench or barricade themselves, by Fellings, or *Chevaux de Frise*, as they extend themselves.

This halting Place, I think, cannot be better placed than on the Flanks of the Intrenchment, which protecting beyond them will flank them; without this, we could not give them too great Depth; I think there cannot be less than 60 Fathoms, that the Troops may not be confused by those who file off in their Rear.

As these Intrenchments extend in Proportion to the Numbers that enter, one of the Extremities must be left open: M. de Santa Cruz, to remedy this, proposes to cross the Intrenchment down to the River at every 300 or 600 Paces, or to supply this by a Redoubt.

This Precaution is exceeding good, but thus the Ground is broke, embarrassed and diminished. If the River is narrow I think we may avoid this additional Work, as the Enemy will not be able to attack us, without being flanked by the Intrenchment on the opposite Side, which before all Things ought to be raised.

It is extremely necessary, if not indispensable, according to this judicious Author, to construct a second Bridge, when the first is finished, was it only to avoid the Danger of having the Communication of those that pass first cut off, if the Artillery, or any other Accident, should damage the first Bridge.

Pl. xxviii.

The Intrenchment, either entirely, or the greatest part, must be included, between the two Heads; from thence results this great Advantage, that if one of the Bridges should be broke, the Remainder of the Army can march to support the Work that covers it, and supposing the Line finished, are in no Danger of being flanked.

The Heads of the Bridges have Gates, because they must subsist some Time, and must also communicate to the right and left, but they are not made in the Lines.

When all the Army, or at least a Number nearly equal to the Enemy, have passed with the Artillery, if they would advance, each Battallion throws down the Parapet before it, and the Counterscarp into the Ditch, to march out in Battle, and thus avoid the Danger of filing off.

Thus we see what Care and Attention is necessary in so hazardous an Enterprise; they must endeavour to deceive the Enemy, to have time to raise the Intrenchment and the Batteries to defend the Access to the Bridge; this Intrenchment should be favourably situated, either by Superiority of Ground or an Elbow in the River, which helps to cross the Fires in Front. *Lastly*, The Troops on the other Side must work half at a Time, each having his Arms grounded two paces before him, and the other half, prepared for an Engagement, must cover them: They should relieve each other every Hour, and if the Enemy attack them before the Parapets are formed, they must defend themselves in the Ditch, where they will be covered by the Counterscarp, and better assisted by the Fire on the other Side, which by this Means they will not intercept.

III. Of all military Operations, perhaps the last is the most dangerous, excepting that of repassing Rivers in Presence of an Enemy, where one Part of the Army is consequently liable to be attacked in Rear, when the other cannot assist it.

Few

Few Authors have touched on this important Subject : M. de Feuquieres would have us inclose ourselves in good Lines, whose Extremities, supported by the River, are flanked by the Fire of some large Redoubts on the opposite Side ; that the Bridges, for he supposes many, and we cannot have too many in so critical a Situation, that the Bridges, I say, be covered by a second Intrenchment, well lined with Infantry, and besides, a Redan to the Tail of each Bridge, for the Facility of raising them.

He also recommends these other Precautions, which though they do not immediately belong to Fortification may here be of Use : " The light and heavy Baggage, says he, should go before the Army a considerable Time ; the Cavalry also before the Infantry ; the first Infantry that pass should be posted and intrenched on the other Side, in Redoubts, which should protect the Flanks of the Army ; nothing of this motion should be seen by the Enemy, that they may not attack on the March, because the Disorder in such a Case is to be dreaded ; and if the Enemy are in Sight of the Camp, the Army must march in the Night only ; but the second Intrenchment, the Redans and Redoubts, must first be lined ; and a Time chosen, when the Enemy may not be able to see the Movements."

On these Instructions, I shall propose the following Plan, tho' I do not think myself obliged strictly to follow them.

These Works inscribed one within another, and consequently of different Contents, are evidently designed that the Troops, successively retreating, may be sufficient to line them, in Proportion as their Numbers decrease ; for when there remains but six or eight Battalions, it is certain they might be forced in that vast Intrenchment, which contained the whole Army, whereas they are in a State to support themselves in the Heads or Lunettes of the Bridges ; but, I find

the Space between the Line and these Pieces too great for one Intrenchment only.

Supposing it necessary to repass a River, when one is not Master of the other Side ; (which is rare, and supposes the Enemy much superior in Numbers) to this difficult Operation would be joined that of passing by open Force ; but as that is not the Case here, the Redoubts M. *de Feuquieres* proposes, are only proper to secure the Heads of Bridges against Surprises, or as we may be in Danger of being attacked, before reinforced by some light Troops : We should then prefer, or rather add, (for this Precaution is always good) a plain Line, which shall close the Communication from right to left, and will flank all within its Reach with a very great Fire.

Pl. xxix.

IV. I now come to the Plan I mentioned, and which needs no Description, the Plate being sufficient to explain every thing. I suppose with M. *de Fouquieres*, that we are generally freed of all our Baggage, and also whatever Cavalry we think we shall not want, with the Infantry to line the Intrenchment on the other Side, passed over ; this Infantry may be four Battalions, I here suppose six.

If it is thought these Detachments would weaken us too much, the exterior Line must be put into such a State of Defence, as to supply this Defect before they are sent over.

This Intrenchment and the Works being finished, the third Line begins the Retreat, followed by the second, that is, by the rest of the Cavalry. The 51 Squadrons are divided into Detachments of 17 each, and each Detachment passes over the Bridge nearest to it.

This Movement is made in the Night, to keep it from the Enemy's Knowledge : Yet if they should discover it, and take that Opportunity to attack, which they will do in the Center, to avoid the Fire of the Intrenchment on the other Side the River, the Infantry at the Extremities of the Line separated by

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the Traverses, must abandon that Post and replace that of the Cavalry in the Center.

But if all is quiet, these 12 Battalions file off, four over each Bridge : The six Battalions in Column begin their March, and are followed by the 24 others, one third over each Bridge.

For greater Security, these Corps may be removed alternatively, that is, from two take one, that the remaining by their Extent may be able to line the Parapet ; they may even be doubled, the Battalions thus becoming six deep.

At length only the Redans and the Intrenchments which support them are occupied ; they retreat from these, beginning by the Intrenchments, and leaving in each Redoubt * but two Companies of Grenadiers, who having taken up or destroyed the Bridges, retire in Boats furnished with Poles and Oars, and drawn to the other Side by two or three Ropes fastened to each.

These Reduits should be formed, by two Rows of Pallisades, one Foot distant from each other, and if it seems necessary, with a third Row of inclined Pallisades.

The Troops, thus successively occupying Intrenchments proportioned to their Numbers, are always able to line them, and consequently to defend them.

They will also be vigorously supported by the Fire from the other Side of the River, the Batteries of which nearly flank the Line, the Traverses and Redans. These last Pieces, also their Redoubts, are flanked as well by the six Battalions, as those who shall have passed over, before it was necessary to defend them.

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* A Field Reduit is the smallest Work made on the like Occasions, but in fortified Places it signifies any Kind of small Citadel added to Places already built, and formed by prolonging the Banks of two Bastions, and constructing a Polygon with that Extent towards the Town ; or by intrenching a Bastion only at the gorge, with an Angle salient towards the Town. The Redoubt of Ravelin, or Half-moon, when very small, is also called a Reduit.

I traced the Flanks and Traverses *en crêmaillere*, or indented, that the Cannon might flank them the better.

Altho' this Camp only supposes 60 Battalions, it would be sufficient for fourscore, by replacing the 20 Squadrons of the second Line by so many Infantry, from whence they might repass the River, as soon as the Works should be in a State of Defence; this Cavalry should post themselves on the right and left of the exterior Intrenchment, where they would be covered in Front by the Fire of the Branches, and in Flank by that of the opposite Side; for greater Precaution some Redoubts may be thrown up there.

If this Scheme is objected to, as requiring much Work, I answer, that the Safety of the Army requires it, and nothing but Tools are wanting, for there are more Troops than needful to execute it in a very little Time, and without displacing them. As to the Intrenchments on the other Side of the River, if its Banks be higher, or both Sides on a Level, it is sufficient to hollow it in Form of a Trench by throwing the Earth on the outside, which much shortens the Works. In whatever manner it is done, we must always begin at the Extremities, because these Parts being designed to defend the Flanks of the exterior Line, will be most wanted. As to the Batteries so far from being sunk, they must be raised and placed so as to command at a Distance in Front.

V. The Method the Prince of *Conti* took to repel the *Rhine*, in 1745, with the Army under his Command, is so good an Example, that I should have nothing more to propose, were Circumstances always the same.

The Right Wing of our Army, supported by the Rivulet and Morass of *Hoffeim*, was covered by Redans, each large enough to contain one Battalion. They We also possessed the Village of *Bobstat*, within Reach of which were the only Openings by which the Enemy could enter the Plains.

The Left, supported by impracticable Morasses, and covered by the little River of *Weischnitz*, was only accessible by the Causeway and Bridge of *Wattenheim*, a large Village towards the Extremity of the Line.

While the Redoubts on the Right, and some others towards *Bobstat* were raising, we constructed five others at some Distance from the Tails of the two Bridges we had flung over below *Rhin dur Kheim*. These Redoubts were so situated, that the Enemy could not penetrate until they had forced them all; which was the more difficult and tedious to be done, as being well guarded, they reciprocally defended each other, and could not be attacked but one after another.

All our Baggage being sent over the *Rhine*, and the Works finished the Day following at break of Day, some Troops of Cavalry, one Regiment of Hussars, and the independant Companies were drawn up between *Bobstat* and the Rivulet, and the Foot Brigade of *Britany*, designed for the Rear-Guard, were posted in the Hedges beyond *Nordheim*, after which the Army, being drawn up at the Head of the Camp before Day, begun to file off in five Columns, three of Infantry, with their Fronts equal to one Battalion, and two of Cavalry; The Artillery divided into four parts, were in the Intervals.

The Troops which guarded the Openings of *Bobstat*, being on their March, were attacked by 6000 Hussars, Croats, or Pandours commanded by General *Trips*, who made some Squadrons give way, and falling on the Rest, put them into Disorder; but the whole quickly rallied behind a Reinforcement of Cavalry, sent from the main Body, who having stopped by the Enemy, rejoined their Column.

They were yet more unlucky on the Right. Those who passed by *Wattenheim* were vigorously repulsed before *Nordheim*, and the Enemy resolutely followed the Troops who retired from this Post, till the

Fire of the first Redoubts stopped them, and the Brigade of *Britanny* facing quickly to the right about, pursued them close with fixed Bayonets and drove them back to the very Village.

In the mean Time the Army filed off with all Expedition; when the main Body and Artillery had passed the *Rhine*, the Rear-Guard and those of the Redoubts, which we successively evacuated, followed.

We had no more than 15 Companies of Grenadiers to line the Intrenchments of the Tails of the Bridges. They all came over except 100 Men, who staid until the Bridges were taken up, which was done so hastily, that the Violence of the Wind and Current having broke the Cables, we were obliged to burn some of the Boats.

The Bridges being at some Distance from the Shore, the 100 Men set Fire to a Heap of Fascines and tarred Wood, which serving as a Shelter, gave Time to this little Body to embark in the Boats which waited for them.

This famous Retreat, made in eight Hours, without the least Confusion, cost us no more than 200 Men, killed, wounded and Prisoners, and the Enemy lost above a Thousand.

There are not I believe many Examples of passing so considerable an Army over such a River as the *Rhine*, in broad Day, with so much Order, and so little Loss. The Choice of a Camp, the possessing of all the advantageous Posts, the Disposition of the Troops, always within Reach to support each other; the Artillery, Redoubts and Works, in fine, the Detail of many other Circumstances not belonging to the Subject in Hand, prevent my saying any thing more here of so skillful a General.

The five Redoubts, capable by their Position to cover a numerous Body, have in some Measure the same Effect as my exterior Line. The Bridges were covered by one Work only, yet the Size and Figure also answered the Intent of the two Redan-

and the intermediate Intrenchment. The Curtain was brisured, because the Saliants were so far distant from each other, as to require these new Flanks; in fine, two Batteries on the opposite Bank, defended the Acces to this Head.

These Works much les considerable by their Extent, than by their judicious Disposition, were sufficient to secure the Retreat of a good Army, well conducted, full of Confidence and Courage, so that any additional Works would have been superfluous; but if I may speak my Mind, I believe M. *de Artus* who directed them, would not have thought them so, with an Army that had been beaten, discouraged, and where consequently, it is to be feared, the most exact Order is not maintained; in this Case I think my Scheme more agreeable.

VI. Having thus far treated of passing Rivers, I might be justly accused of Neglect, if I said nothing of the Means of preventing these Passages.

Is it not a Paradox to assert that this Operation is as difficult as the other? Yet it is true, if not in itself, at least by Circumstances. Nothing is more difficult than to pass when an intelligent Enemy opposes the Passage; it is even impossible, if they lodge first on one of the Banks; yet nothing also is more difficult than to hinder the Passage, when there are many Fords, or Places where Bridges can be flung over; because to guard these Places reduces an Army to nothing; and in this Case, as *Feuquieres* observes, "the General who extends his Army, has the least Prospect of succeeding."

The best to be done on this Occasion, I think, is to throw up small Redoubts, not only in the suspected Places, but in their Intervals, and near enough each other to form a Chain of Centinels and Patroles, and if the Country is on our Side, fifteen Peasants is sufficient for each, who by these Works will not be in Danger of being surprized in the Night, by Parties who might cross in Boats: When they discover any

any extraordinary Motion, they make an appointed Signal, which being repeated from Post to Post, passes in a Moment from right to left, time enough for the adjacent Corps to arrive : This I saw practis'd in *Alsace* during the last two Wars.

When there is an Island within Reach, it must have Troops posted in it, and some Works to cover them ; at least, all the Wood and Bushes should be cut down, that nothing may pass unseen. Had we taken this Precaution at *Spire* in 1735, the Imperialists could not have burnt our Magazines, close to the Gate of the Town, with Bombs and hot Bullets. I here suppose a deep River; when it is not so throughout, the Fords must be deepened in the Manner I shall shew in another Treatise.

In both Cases, if there are many Places easy to get over, Intrenchments must be raised on the Bank before it, that the Troops which march on the Signal given, may enter them at their Arrival.

These Intrenchments always useful, are often absolutely necessary ; for if the Enemy come with a considerable Train of Artillery at the same Time with your Troops, it is probable that not being able to sustain the Enemy's Fire without these Intrenchments, they will be quickly obliged to quit the Spot.

VII. There are so few Schemes of this nature to quote, that it would be an Affectation to pass by those *M. de Folard* has proposed on this Subject, tho' the first does not appear to me clearly expressed.

" The best Way, says he, is to make strong
 " Epaulements, crossing or in a Curve, at 80, or 100
 " Fathoms from the Place where it is thought the
 " Enemy can pass ; the two Horns or Extremities of
 " the Curve must be 20 Fathoms from the Side of
 " the River, that they may not be enfiladed by the
 " Enemy's Cannon, and that there may be room
 " enough on the outside to cover a great Body of

" Cavalry

"Cavalry and Infantry. This Epaulement should be 7 or 8 Feet high, the Earth cast towards the Enemy, as we make our Trenches, and it must have a gentle Slope; it is behind this little Hillock of Earth, and covered from the Enemy's Cannon, that we wait at the Pass."

When a certain Number of the Enemy having passed, they shall begin to form in Spite of this cross Fire, which, as the Author observes, will take them in Front and Flank, "The Cavalry mount—their Horses, and march towards the Enemy, with a Grenadier behind each, whom they set down, when within a certain Distance, to form Platoons of 50 Grenadiers each, who are to engage with them, between the Squadrons."

This last Passage I do not well understand; it may be want of Conception on my Part; tho' it would not be astonishing, if in so great a Work, and wrote with so much Spirit, an Author full of his Subject, should not be equally intelligible throughout.

The Figure so far from explaining, rather embarrassed me the more, by the small Depth of the Intrenchment, in respect to the Felling and Number of Troops drawn up there, if I was not assured, that the same Plate serves for two different Manoeuvres.

I have nothing more to add on this, only that the Depth of the Curve being determined at 80, or 100 Fathoms, it will be straiter in Proportion to the greater Body to be covered without, and the straiter it is, the less it will flank the Enemy; in fine, supposing even the Figure elliptick, the Center will only be defended in Front by small Arms, if the greater Axis exceeds 240 Fathoms, that is double the Range of a Musket.

The gentle Slope of the Epaulement, shews plainly that we are to mount by that to attack, which is an excellent Thought at least for the Infantry, as they can make it from every Part at once, and there will be one

one Part covered from the Fire of the opposite Side, by the Enemy themselves ; but in this Case, of what Use are the Passages of 20 Fathoms at the Side of the River ?

In fine, if the Troops are behind the Epaulement, what Necessity is there for advancing with the Grenadiers mounted ? It ought not to be those, but others that should march to reinforce them.

I must yet add, that it is not my Fault if I cannot give a better Explanation, having applied to the Author for that Purpose, but after waiting a long time without receiving the Explication which he promised me, I was obliged to go without it. I say this in my own Justification ; for in my Opinion, it is unpardonable to quote obscure Passages, and complain of their Obscurity, when by writing, or speaking to the Author, it is easy to have them explained.

VIII. I should not be much more excusable, for referring to Ideas, which I look on as imperfectly expressed, if I did not, in so doing, draw the Advantages the Author proposed ; and which perhaps I might find there, if I understood them better.

The following Method I think answers his Designs ; The Curve Figure propos'd, tho' little practis'd, is convenient, but it requires Attention and Choice. The more the Curve approaches to a strait Line, the easier it is to conform to an essential Maxim of his, which is, that the Exterior be covered throughout : Besides the Order of Battle will be less broke, the Front of the Troops which must line it, approaching the nearer to a Right Line.

The Elipsis must therefore be rejected, as having Parts where the Curve is too abrupt ; and for a much better Reason the Semi Circle, which besides that Inconvenience, cannot be formed with a Radius of 80, or 100 Fathoms, (the smallest Range of a Musk- et,) as the Epaulement would not have Extent enough.

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The first Scheme is constructed on these Principles: pl. xxxi. it is the Segment of a Circle of 128 Fathoms Radius, Fig. 1. and has 80 Fathoms reentrant from the River, which determines the Chord at little more than 226 Fathoms.

This Method is good, as the Fires drawing nearer together, in Proportion to the Circumference, cannot but have a great Effect, as well on those that have passed, as on those that are passing; but it is not easy in Practice to trace the Portions of so great a Circle.

For that Reason, perhaps the second Figure may be pl. xxxi. preferred: The Opening is 240 Fathoms; the Middle Line 60 Fathoms long, parallel to the River, and 10 Fathoms distant from it.

This Line and those of the Sides being strait, the Fires of each are parallel between themselves, but they cross a considerable Space, (when those of the first Plan, in the Segment of the Circle, approach and unite) which may be thought more advantageous.

If that is not approved of, we may approach the pl. xxxi. circular Line as much as we please, by dividing the Fig. 3. Chord into as many Parts, as we design the inscribed figure to have Sides, and finding by Calculation or Scale, the Length of the Perpendiculars.

Which ever Method we follow, the most essential point, is to cover the exterior of the Work, so as not to be seen from the opposite Side of the River, which will be at least 400 Fathoms distant from it, this is sufficient in Respect to the Range of Field Pieces, and the Uncertainty of firing at so great a Distance.

This cannot be done but by Epaulements, whose length will depend on the Figure of the Course of the River; if it forms a Rentrant towards you, they must be shorter, if the Elbow runs from you, they must be larger; we here suppose the Course in a right line.

These Epaulements must be so disposed, that the Troops may not be constrained in their Manoeuvres, on the Rear of the Extremities of the Work, that the

Files

Files of Troops be not square with their Front. It is on this Maxim, that in the last Plan I made them perpendicular to the Sides. The Crotchet Parallel to the River, and also the adjacent Parts on the Right and Left, are designed for Artillery, which batters the Access and the Passage of the River, and the Enemy's Cannon almost direct.

There only remains one Observation more to make, it is concerning the Profile of this Work. These gentle Slopes, that the Cavalry may ascend and descend, (which I believe is the Meaning of the Author,) would be very advantageous to draw out in Line of Battle; but their Construction will be found very difficult, if we give seven Feet and a half for the Height of the Epaulement, as they must have at least 30 Feet Base, which added to the Thickness at Top, makes at least 11 Fathoms at Foot, and seven Fathoms and a half solidity in every Fathom length; but independant of this excessive Work, it is plain what trouble there will be, in throwing the Earth so far, especially taking it only from one Side, and how much the Ditch adds to this Distance and the Length of the Slope; besides it is obvious that the least Rain renders such a Passage absolutely impracticable.

The whole is remedied thus: Let the Part of the Epaulement designed for Cavalry, have only the natural Slope, that is a gradual one, with one or two Openings of 36 Feet each and masked, at a Parallel or proportioned Distance, will serve as a Passage.

The Epaulement for the Infantry 6 Feet high, and its Talus, one Foot and a half to a Foot, that the Battalions may leap over, without filing off.

Thus in one Case, we have about half, and in the other two thirds less Earth to remove, and it is taken within and without, which greatly shortens the Work observing to make the Excavation as broad as possible that it may have the less depth.

The Parados, or Epaulements of the Flanks, will better guard against the Ricochet, if we give them the Height

Height of the first Profile, when the Infantry are on the Sides. They cannot be less than 8 Feet high to cover a Man on Horseback, supposed on a Level with the Enemy, as I do here, and which without doubt should be taken as a Rule.

IX. *Folard's* other Schemes, relate to those Elbows, or Turnings in a River, where the Defendants cannot engage, without being taken, or battered in Front, Flank, and sometimes in Rear.

They give the Enemy great Advantage, no doubt; but to use the Author's own Words, not so much as is commonly said; for these Windings are, at least in part of their Extent, enfiladed, and seen obliquely from the Points where the Curve begins.

To profit by this Circumstance, he raises a Redoubt Pl. xxxi. at each of these Places, capable of containing 150 Fig. 3. Men with Cannon; the rest depends on the Number of Troops that may be thought necessary to sustain the Post.

If there is a Body of Cavalry and Infantry within Reach, considerable enough to charge those who may endeavour to force it, we shelter them from the Enemy's Cannon, by joining Epaulements to these Works, of the kind we have spoken of; which is shewn on the Figure.

But if we have only Infantry, and the Number of these Windings does not permit us to employ sufficient Forces at each of them, we draw a Line from one Redoubt to another, the Middle of which is covered with a Lunette, to which it communicates.

In fine, if we can only guard the Redoubts, they must be so constructed, pallisadoed, and defended, as at least to hold out till Succours can arrive; the same must be understood of the Lunette and Intrenchment.

I thought to have flanked these Redoubts, and to turn them and the Line which joins them, in a Manner most proper to have fulfilled their Design; but it is in that only, I here differ from *M. de Folard.*

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We must observe, that in this, and the preceding Article, he supposes the River fordable; for if it was not, less Work would suffice to hinder a Bridge being thrown over. His Epaulements are yet very proper for this Use, since if the Bridge was finished, it would be useless, on Account of the Facility of successively battering the Troops that might endeavour to pass.

CHAPTER THE ELEVENTH.

- I. Of Gates. II. Of Communications. III. Of Platforms. IV. Of Epaulements for Cavalry. V. Schemes of intrenched Epaulements. VI. Of Bog-Houses. VII. Manner of covering the Gates of common Lines. VIII. Of covering those of the different kinds of Lines proposed. IX. Advanced Ditches; their Advantages. X. Of Half-moons.

LINES, I shall henceforth comprehend under this Name all Kinds of Intrenchments that can be applied to it: Lines I say, have occasion for certain Works, some of which facilitate the necessary Movements, and others contribute to the Security and Convenience of the Camp: Such are Gates, interior Communications, Platforms for Cannon, Epaulements for Cavalry, and Bog-Houses.

The Number of Gates to be made in Lines depends on the Number of Troops destin'd for their Defence, the design of the General, and the nature of the Ground.

There were but few Gates in the Lines of Philipsburg in 1734, and they were not larger than those in the Places of Arms of a Covert Way. The Reason of this might have been, that our Cavalry being sent back for want of Subsistence, to the other side the Rhine, weakened us greatly; and that we had a numerous Army a-head of us, and that the taking of the Place was our sole Object, as it was so immediately necessary, as the Overflowing of the Water deprived us of all Communication from one Side to the other.

We may also use them for those Lines, which are only accessible by few Roads, or for those, before which there is not Ground enough to draw up; but these Cases are Exceptions to this Rule.

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We cannot, generally speaking, procure too many Passages; as they are necessary in advancing or retreating, they are as I said before in Chap 5, the only means of abridging the time lost in filing off, and consequently of removing the Defect M. *Feuquiers* has so justly remarked.

Another Motive, not less important, should engage us to this; tho' the Enemy Masters of the Parapet leap over in some Places, while the Corps afar off advance to charge them, a Sally of some choice Troops, made briskly from right and left, and at a small Distance from the Part attacked, is, as M. *Santa Cruz*, and *de Folard* remark, one of the best Manoeuvres that can be made; but to do this the Barriers must not be too far distant from each other.

Vauban in his Treatise of the Attack of Places, allows 22 Feet, for the Width of these Gates; he preferentially places them in the high Roads, in the Middle of the Curtains, or near it, and covers them as we shall find hereafter.

What he allows for Lines of Circumvallation, is equally agreeable for those we are speaking of; the Passages are thus wide enough for the Cavalry to rank off by fours, and the Infantry by eight: Certainly a beaten Road is preferable to a new one, and the Passage cannot be better placed, than in the part the best flanked.

II. One point this illustrious Engineer insists on, is that of a Communication; there a few Places that are not situated on Rivers small or large, which consequently cuts the Besiegers Lines into two. The kind of Camps we are speaking of, are not so frequent in this case, but it may happen, and besides we commonly find Rivulets, Ditches, fenny Grounds, hollow Ways and Thickets.

Every Thing that may hinder, or retard the Assistance, that one Part should give another, is so essential an Inconvenience, that in the words of that Author,



the Safety of an Army may depend on it; we cannot therefore be too attentive to this Point.

If the Right is separated from the Left by a River, he would have three or four Bridges constructed, each 4 or 5 Fathoms broad, and 50 or 60 Fathoms distant from each other, to avoid Confusion, and their Extremities defended and covered by Redans.

This I believe can be best done by Boats, in regard to their length; but if the Bridges be on Chevalets, which he prefers, as being more firm, and less liable to Disorder, I don't know if, according to *Folard*, it would not be better, that they were broad enough to pass over by Divisions at least; for, says he, "it does not require more time, or trouble to make a Passage, or a Bridge of 100, or 120 Feet broad, than many of 13, or 15." This is undeniable, and it is certain that more can pass over one Bridge 120 Feet broad at once, than over four of 30; as these narrow Bridges often oblige the Column to halt, while the Head passes over: In fine, the more there are together, the stronger and in better state they are to charge, after their Passage.

Which ever Method we take, if the Camp is cut by Rivulets, Ditches or hollow Ways, we practise the same as for Rivers, where we make the slopes broad and gentle enough for Cannon and Cavalry to pass easily: if any part is Marshy, Causeways are formed, of the same Breadth as the Bridges.

The Bushes, Brambles and Thickets, which may be found near the Intrenchment at the Tail of the Camp, must be cut down close, that the Horses may not stumble over the Stumps; in fine, omitting nothing in so important an Article, multiplying the Bridges, and other Means, in Proportion as we can spare Time and Workmen.

III. Platforms for Cannon are formed at the same Time with the Line; they are commonly in the most salient Parts, that is to say, in the flanked Angles, where there is always more Earth than necessary; by

this Position their Fires cross the better, and reach the farther.

These Platforms are raised to 2 Feet below the Crown of the Parapet; if the Excavation of the rounding of the Ditch does not furnish Earth enough to make them as large as needful, and to form the Ramps, or Slopes, the Officer of the Artillery, whom this more particularly regards, finishes them with his own Men.

IV. The Author I just now quoted, mentions Epaulements to cover Cavalry, as a Precaution that has been neglected these 50 or 60 Years past; he does not say why the Practice ceased, but perhaps it was because of the short Duration of most Sieges; whatever was the Reason, as he proposes them in Countervallations, I may be permitted to give my Opinion of them here,

When we attack Lines in broad Day, we commonly cannonade them for many Hours, before we attempt to force them; then in whatever manner the Infantry be disposed, the Parapet must be very low, and very bad, if it does not cover them and the Cavalry, (that is the Corps which should engage the last, and behind which the others should rally in case of need,) remains needlessly exposed to all the Violence of this Fire.

This, which I look on to be Fact, discovers my Sentiments on this Subject; it is true we do not now practise these Epaulements, but is that a Reason we never may?

Tho' their Utility appears evident to me, I do not pretend to say, they must be raised on all Occasions; for Example, when we intrench in haste, in presence of an Enemy, we must not do by halves what is absolutely necessary, and lose time, in what may only be useful by Chance: besides will it not be the height of Imprudence to fatigue the Men too much, who must engage a few Hours after? So far from that, I would have these Epaulements made only in those Lines

Lines, and at Leisure, which may be of use as long as the War lasts.

There is also some essential Circumstances to be observed in replacing these Works. "We raise them, says *Vauban*, principally in the Parts commanded from without, seldom in any others." It is certain, it is there they are most wanted, but they will yet be very useful in level Ground, especially if the Intrenchment be weak; but if the Parapet of the Line, by its Construction or Position, will cover the Cavalry, or if the Ground on which they are drawn up be so low, that they cannot be seen over the Parapet, then such a Precaution might be ridiculed, as the Line itself serves instead of it, altho' always less perfect, because the Troops, at a Distance from the Parapet, are most exposed to the Enemy's Shot.

These Epaulements, generally placed in the most open Places, have one more Advantage (supposing Cavalry in Proportion) which is that of covering the Front and sometimes the Rear of the Camp.

I never did see them but at the Lines of the *Loutre* between *Wissembourg* and *Alstatt*; but they were half in Ruins: M. de *Vauban* placed them at an equal Distance from the Line and the Head of the Camp, parallel to them: He made them about 40 Fathoms long, 9 or 10 Feet thick, and as high; and 50 or 60 Fathoms interval between each.

V. It is common with the more northern Nations, to place Platoons of Infantry between the Squadrons: This, which was so well known to Comte *de Montecuculli*, and so much recommended by the Commentator of *Polybius*, has often succeeded with the *Swedes* against the *Germans*, and with the *Germans* against the *Turks*. Such a Fire, always very brisk, and better directed than that of Carabines, is in Effect very proper to protect the Manoeuvre of the Cavalry; may it not then be here as advantageous, at least in certain Cases?

The Cavalry of the Line being repulsed and half broke, I would have them rally behind these Epaulements ; and to give them Time and Means to do it, there should be a sudden and smart Fire, that they may not be followed too close.

A Sheme I proposed in 1735 for raising a Battery at Philipsburg to defend our Forage, appears to me perfectly convenient here. We may form the common Epaulement, only observing to make a Banquet in its Ditch, and to raise its Counterscarp like a flat Parapet, about two Feet high, that the Fire may be the better directed.

It is obvious this will not occasion any Increase of Labour ; and I believe that an Epaulement thus lined, with 50 or 100 Soldiers, firing nearly level with the Ground, would be very terrible, and prove a great support to a disordered Troop. This Construction has yet this Advantage, that if Circumstances do not permit it to be used, there is no Inconvenience follows.

In Places level, but of small Extent in Proportion to the Quantity of Infantry to be disposed of, a Banquet may also be made behind the Epaulement, and the usual Slope given to the Parapet : Two Lines of Fire thus disposed, must probably have a great Effect, as the Depth of the Ditch, and the Talus of the upper Banquet equally protects the Soldiers above and below from the Stroke of the Enemy's Cavalry.

The Crotchets, as in the Plan, also seem good to cover them from oblique Fires ; they form little Flanks from one Epaulement to another, and even cover each other if the Enemy come on the Flanks, and in this case also, the two ends of the Ditch, formed like the rest of the Parapet, will greatly strengthen this Defence.

VI. I shall only mention the Inconveniences of Bog-Houses ; wherever they are placed in the Lines, they are always troublesome : if without, they facilitate Desertion, if within, they are a Nuisance, and break the Line of Battle.

VII. If

VII. If we do not take Care to cover the Gates, it is plain, that the Enemy's Cannon will break the Barriers, and firing through, will batter one part of the Camp in proportion to its Situation and the Breadth of the Openings.

The Custom in common Lines is to cover them Pl. xxxiii. with detached Redans in Form of Half-moons. *Vau-* Fig. 1. *an* makes the Capital 22 Fathoms, and the Faces 18: The Gorge is thus 34 Fathoms, 3 Feet, 10 Inches; which, not agreeing with the sides of the Figure in the Book, proves there is some mistake in the Numbers.

He forms the Flanks by taking 10 Fathoms from the Face, and 5 from the Gorge, but making thus an Angle of $98^{\circ}, 35', 30''$ only with the Counterscarp, all the Fire is directed towards the next Redan, which gives Room to suppose, that the principal design of these Flanks, useless in themselves, is (by shortening the Faces) to give more effect to the Fire of the Curtain, of which they yet mask near 25 fathoms.

The Ditch of these Works, parallel to the Faces, must be prolonged to that of the Line, that it may be commanded throughout: By this we are obliged to use and remove a great quantity of superfluous earth, and which must be esteemed an Inconvenience, but much less than the other.

Besides, these Halfmoons produce a very good effect: the Fire of their Faces, crosses near the Capital of the Redans, which as we have observed, have great Need of this Assistance; and it perfectly covers the Gate and the Bridge. An Advantage very desirable in the half Moons of Places, which often are abandoned for want of a sure Communication.

I see nothing more to be observed on this Head, except, that supposing the Counterscarp 3 Fathoms from the Master Line, as one of the Lines of Fire the Redan will pass at least six Fathoms from the point of the Half-moon, we cannot diminish the

Front more than 15, or 16 Fathoms; for if, for Example, it was reduced to 100 Fathoms, this Point would be battered.

Pl. xxxiii. Fig. 2. VIII. A few Words added to the Inspection of the Plans, will shew my Method of covering the Gates of the different kinds of Lines proposed.

For those with Redans, where the Barriers cannot be better placed than in the Saliant of the Curtain, mask them with a Lunette of 16 Fathoms Capital, reckoning from Angle to Angle: make the Faces 20 Fathoms long, drawing them to the Rentrant of the Redans, and the Fire, supposed Perpendicular, will graze, without battering them; I here mean the second Scheme of 150 Fathoms Front, which on that Account is preferable to the other. The Extremities of the Ditch of this little Work, if not full of Water, must be prolonged in a Glacis reversed, that the Enemy may not find any Shelter.

Pl. xxxiii. Fig. 3. A Lunette of 20 Fathoms Capital, and 15 Fathoms demigorge, placed at the Rentrant of Lines with Tenailles, will cover their Barrier.

Pl. xxxiii. Fig. 4. That of Lines à Cremaillere, are masked by a Reduit formed on one Side by the Prolongation of the Branch, and the other Parallel to the Crotchet.

The Excavation of the Branches of the Communication, that is, the part of the Branches between the Tambour and the Ditch, serve for the two kinds of Lines with Lunettes, and thus save so much Work.

The Bastion Lines in this Respect, are much more difficult than the Rest, and unfortunately I cannot quote those of Philipburg, for their Barriers were not covered. The Difficulty arises, by supposing, as have done throughout, the small Arms to fire at right Angles; Half-moons cannot well be used, for they are only separated from the Faces of the Bastion by the Breadth of the Ditch, they mask almost all the Fire of the Flanks, as I have said already; and if they are as far from the Faces, as should be, that is to say, the Length of the Flank, we not only re-

the risk of having these Pieces flanked, and taken in Rear, by the Gorge, but also the Communication would not be so secure, and the Barrier wou'd even be seen obliquely from the Extremities of the Shoulder.

I have given two Ways of avoiding these Inconveniences, the Reader may decide which seems to merit Preference.

The first is to make a *Fausbraye* before the Curtain: It is 12 Fathoms broad from the Master-Line, Fig. 1. that Carriages may pass easily, and that they may be flanked by the Bastion.

The second is a little more compounded; draw a Line from the Shoulder of one Bastion to that of the next; divide this Line into two, and from the middle let fall a Perpendicular, equal to half this Line, its Extremity will be the Point of the Angle of a Redan reversed, whose Branches are drawn from that Point to the Shoulders of the Bastion. The Curtain being thus brisur'd a second Time, raise a Parapet on the first Trace, and it will shew the Figure.

This reentrant Angle being a right one, and its Branches grazing the Shoulders, their Fire, tho' less advanced than they were, pass beyond the Capitals of the Bastions and cut them, which must be an Advantage.

Detached Bastions are exceeding good to cover Gates, and the Lines with detached Works, or those detached in Parts, having no Occasion for these additional Works, I have nothing more to add to this Article.

IX. In my Maxims, I said we might, without Danger, even in dry Ground, cover every flanked Work with an advanced Ditch, provided the Flanks were not too oblique, and sufficiently salient; I will here explain myself.

An advanced Ditch will be always useful, and cease to be dangerous, when seen and battered throughout its Extent; the Enemy will then not find that Shelter, that Cover, and that Security, which have

have made the greatest Masters reject them; in fine, the Enemy will be as much exposed there, as on the Counterscarp.

To effect this, 1st, The advanced Ditch must be enfiladed at right Angles, or at least under an Angle, from 90 to 100 Degrees, with the Flanks of the Line: 2^{dly}, Consequently its Distance from the Ditch must be such that its Counterscarp does not project beyond the interior Angle of the Shoulder, that the whole Ditch may be under the Fire of some Part of the Flank. 3^{dly}, That at the Rentrants the advanced Ditch be prolonged, and cut down in form of a Glacis reversed, so as to leave no cover, as I have shewn already.

These Circumstances, which remove all Difficulties, are easy to be observed, in the most part of the Works I have proposed. I will give two Examples,

Pl. xxxiv. Fig. 3. In Lines with Redans, trace the advanced Ditch parallel to the Ditch, because the Angle of the Flank with the Branch is only $99^{\circ} 34'$, which is not too much, and if I had made it Square with the Line, it would have thrown me more than 16 Fathoms towards the Country opposite to the Brisure, and in Proportion opposite to the Point of the Redan.

Pl. xxviv. Fig. 4. In brisur'd Lines with Tenailles, which I here suppose with Lunettes, I do not follow the Master-Line, which lengthens the Ditch to no Purpose, and which would also be much less defended; but it is parallel to the principal Lines of Defence, and consequently squares upon the Flanks.

If to this we add the necessary savings, it must be confessed that this Piece of Fortification, far from being hurtful, becomes useful even in dry Ground.

Its most remarkable Advantages are, 1st, That if the Talus be the least steep, the first Rank of the Assailants, embarrassed with their Fascines, throw them in here to leap over, so that they have them not to fill up the Ditch of the Intrenchment. 2^{dly}, That

far

far from serving the Enemy, as a Place of Arms, to take Breath in, and there oppose the Line with small Arms, as they will find no Cover there, they will quickly leap out of it, and consequently in Disorder.

These Obstacles become insurmountable, if we have Time to dig Pits between the Ditches: Nothing is fitter to disconcert an Enemy in an Attack, or more difficult to fill up. 'Tis with this View, that is to say, that the Enemy may not know where to tread, that in the first Figure, and at the Salient of the second, I have only left about four Fathoms distance, from one Ditch to another, that three Rows of these Pits placed alternately may be sufficient.

The Earth of these Wells is thrown up in little leaps in their Intervals; that of the advanced Ditch, whose Contents is less considerable, may be thrown in form of a Glacis on its Counterscarp.

X. We may draw new Advantages from advanced Ditches, when judged necessary: *viz.* That of constructing Half-moons before the Curtains of bastion'd fronts, without falling into the Inconveniences mentioned in the 8th Article of this Chapter.

It is evident that thus we are freed of the Danger of being taken by the Gorge, without being obliged to mask Part of the Fire of the Flanks: This is an essential Point, yet as there must be a Gate in the Line, to communicate with this detached Work, and we must as much as possible hide this Gate from the enemy, there must be some other Measures taken.

We shall fulfil this Point only in Proportion as we diminish the Distance of the Ditches: Therefore we must particularly observe this.

The Fire of the Flank only beginning from the inferior Angle of the Shoulder, we may without Danger from thence draw the Demi-gorge of the Half-moon, which will thus lessen its Distance from the Master-Line: We do not in Fact gain much by this, but we should much more, if we placed two pieces of Cannon in that Part of the Flank next the Shoulder,

Shoulder, which charged with Grape, and pointed between the two Ditches, at the Time of the Assault must be extremely useful.

Besides, as the Distance is small, these Pieces may be moved from the Flanks to the Faces, having but one to remove entirely.

We may then without Inconvenience draw the Demi-gorge of the Half-moon, and the Counter-scarp of the advanced Ditch, 5 Fathoms from the Angle of the Shoulder, taken externally, so that drawing the Branches of the Half-moon on the Faces, at the like Distance from the Angles, the Barrier, and all the Communication will be pretty well covered.

Pl. xxxiv.

Fig. 5.

This Half-moon is traced according to the common Method, that is to say, taking the Distance of the two Points; where the two Branches of the Half-moon fall upon the Faces of the Bastions, as a Base and constructing two Triangles thereon, one a rectangle, and the other an equilateral, and dividing the Distance of their Summits into two, that Point will be the Point of the flanked Angle of the Half-moon.

These Pieces after all, tho' low and weak, cause great Increase of Work, and I own, as I have done in Chap 5. that I do not approve of detached Works in Field Fortification, especially when we have no means and time to render them capable of resisting an Assault. I therefore think we should only make Half moons to Intrenchments of small Extent, and made with great Care; such, for Example, as in trenched Camps, especially when they can only be attacked in one Part, as those of *Russenheim* and *Spir*.

CHAPTER THE TWELFTH.

Of irregular Fortification : Maxims. II. Of reentrant Angles. III. Of Salient Angles. IV. Manner of occupying Heights, of preventing their being enfiladed, and tracing Works on their Descent. V. Reflections on Heights. VI. Of Villages and Buildings within Reach of the Work. VII. Case where detached Works are necessary or useful. VIII. Of Woods. IX. Of Morasses, Hollows, hollow Roads, Hedges, Rivulets. X. Manner of proportioning to the Ground the Lengths of the Fronts of the proposed Methods.

I have hitherto supposed the Intrenchments raised on level Ground, and the Lines so uniform that all the Tenailles were equally disposed, and in the same Line: In a Word, I have supposed the Works quite regular. I thus followed the Method taken in treating of the Fortification of Places, and I did it with the same Intent, that is to say, to form the Subject, by establishing general Methods, which we follow as much as possible in the Execution; for ground is seldom found so uniform, but that the Regularity is at least as difficult to be observed in one case, as in the other.

We should then much less regard what has been said on this Subject as positive Precepts, than as general Notions, proper to multiply and rectify the particular Ideas, which Circumstances require in Practice. The Engineer must know how to act, according to the Circumstances, and it is a great Advantage to him to have many different Methods to compare, in order to follow that which seems the best.

But we shall presently find how much we must expect from Theory; for the Irregularities of the Ground and other Circumstances, vary so much, that all that can be added to what has been already treated of, is to shew how to profit by certain Advantages, and to avoid,

avoid, and to surmount some foreseen Difficulties generally very common.

I shall give but few Maxims on this Subject; but they are as important as extensive: One, that all Parts be as much as possible, so equally capable of Resistance, that one part need not be feared more than another; its plain in this respect we must regard the Advantages of the Ground: The other, to have a much Attention, to profit by every Thing that may be favourable, as to avoid what may be hurtful.

H. A Turning, a Winding, a Projection in the Lines may be regarded as an Irregularity, but that is almost always unavoidable. If the Angle it forms be a Rentrant, it sometimes increases the Defence if a Salient, the contrary.

Rentrant Angles, right or obtuse, and those which are acute are often fortified after different Methods.

Pl. xxxv. Fig. 1, 2, 3, 4. A Rentrant from 90 to 120 Degrees, though the Defence be very oblique, forms a Tenaille, and consequently flanks itself, provided its Branches, being of a proper Length, shorten by Degrees, as it is more open; so that at 90 Degrees they have but 8 Fathoms; at 100 Degrees 70 Fathoms; and at 110 Degrees 60 Fathoms, and at 120 Degrees they have but 50 Fathoms.

This Shortening is necessary, that one Part of the Fires may cross the Capitals, which could not be without that; for they fly off from the Saliants, in Proportion as the Angle is obtuse. I do not give this as a geometrical Rule, it will only serve in Practice and sufficient in common Cases.

I say in common Cases, for if the Ground on the right and left is not on the same Line, we must have regard to the Difference the Inclination of the new Angles gives to the Capital. The Figure will explain what I mean, and shew that the Salient on one Side, tho' double in Length to the other, can be better defended.

Pl. xxxv.
Fig. 5.

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When the Branches are too long, or the Angle ^{Pl. xxxv.} very open, some Crotchetts *en Cremaillere* remedy all Fig. 6. at once, as they not only form new Flanks, but also diminish the Opening.

As to Rentrants under 90 Degrees, they are fortified according to the Breadth of their Opening : If it is only 120 Fathoms, it will do well enough, as an Enemy would be thereby engaged between two Fires. A simple Parapet in a right Line, always necessary to cover the Communication, and to prevent the Camp from being battered obliquely, seems sufficient ; yet as the Enemy may throw themselves all on one Side, or attack both at once, it is best, that the anterior parts be flanked, and the Branches so disposed, at least for certain Depth, that they may be used without firing on each other.

On this Occasion I shall once more venture my ^{Pl. xxxv.} thoughts, in giving a Scheme for an opening of about 200 Fathoms : I know that in the Treatise of the Attack of Places we find one of these Rentrants fortified to the very bottom *en cremaillere* ; but if we reflect that Branches with more than 200 Fathoms interval, exceed the Range of a Musket, it must be allowed as this is a different Case, I cannot follow this Example without breaking through the Rules.

III. *Vauban*, as well in this, as in his Instruction on the Siege of *Ath*, gives some salient Angles, all formed ; the most open by Bastions, the others of 90 degrees at least by Demi-Bastions, and by the entrenched Camp at *Dunkirk*, it appears that when they were acute he cut them to make Tenailles.

We are seldom obliged to make these last Angles ; as we may have Occasion to possess a Point of land, I will shew in a general Manner how I would sink all from 60 Degrees to the greatest Opening.

The Angle of 60 Degrees, being the most acute ^{Pl. xxxv.} it can be admitted in Fortification, must not be diminished : Its Flanks must consequently be taken internally ; the best for this Purpose, as being the least

least saliant, are Crotches *en cremaillere*, which may serve for all others.

Pl. xxxv. As the right Angle has 30 Degrees more, it may be defended different Ways; I would prefer the proceeding, taking the Crotchet within, if possible, for it will be yet 61 Deg. 56 Min. If a Demi-Bastion is thought best, care must be taken that the Face be defended, and that no part in the Front fires on another; but independant of the Irregularity, it appears to me that we shall have gained nothing, for it is the Salient that must be defended, and two Flanks near 15 Fathoms each, one of which is only 60 Fathom distant, is better than one which is less than 27, and more than double that distance, which is that of the common Redans.

Pl. xxxv. If these Considerations do not appear solid enough trace that Figure in this manner. Draw a Parallel 22 Fathoms from one of the Sides; at 120 Fathom from the Angle, raise a Redan of 22 Fathoms perpendicular, and 15 Fathoms Demi-Gorge; draw one Line of Defence from the Angle of the Figure to the Reentrant of the Redan, and the other from the Point of the Redan to the Gorge of the Demi-Bastion, which make 25 Fathoms; elevate the Flank perpendicular to this last Line.

This Angle being square, might be made a Bastion; but so crowded, and of so little Defence, that we should reject such a Construction here, as much as in the Fortification of Places, where it is never used, when it can be avoided.

Pl. xxxv. The Angle of 120 Degrees, being that of a Hexagon, may be fortified according to all the Methods have given, except in those with Tenailles, and Tenilles brisur'd; it wants but 30 Min. of being enough for this; so that it may be used, diminishing the Perpendicular two or three Feet only, for greater Exactne

In fine, the Angle of 150 Deg. is open enough **Pl. xxxv.** execute any of the different Schemes that may **Fig. 12.** chosen for the rest of the Lines.

Whatever

Whatever then be the Salient, we can flank it according to one or more of the Methods I have given for regular Fortification, and it is certainly an Advantage to confine these Irregularities to fixed Rules, observing only that if the Angle be less than 60 Deg. or that we cannot use the Crotchet, we must make it less salient to give it the greater Opening.

IV. The unequal Heights of the Ground, is one of the principal Causes of the Irregularities, as well in the Profiles, as in the Plan of the Works.

The Saliants of every Kind of Fortification must be at least as high as their Branches, even supposing the Ground perfectly level; for if the Part the most advanced should be lowest, its Parapet would cover it less in Proportion, as one would be farther from it, whereas if the Salient be highest, one cannot be seen even from a much higher Ground than that we are in.

It is therefore always useful, and often absolutely necessary to raise the flanked Angles higher than the rest: The Earth taken from the rounding of the Ditch serves for this Purpose; but as this is of little Consequence, but in even Ground, we must endeavour to place these Angles on the highest Places; we also thus prevent the bad Effects of the Ricochet, and command better in Front.

When we cannot by this means prevent being seen from an Eminence too near, and have not time to raise the Parapet of the Angle as high as needful, there are two Methods left, little or not at all used in France. The one is to raise the Parapet of the Angle some Feet, in Form of a Cavalier, for the Breadth of the Terreplein that the Troops we thus cover would occupy along the Branches. This the Germans call Bonnets, and we Surtouts; there were some in the Hornworks at *Philipsburg*.

If it is only some particular Work we would cover, the same Method is used by turning one or more Angles to the Enemy: These Surtouts are also so proper to guard

against the Ricochet, that I am surprised they are not more used in our fortified Places.

The other expedient signifies little against Cannon, but it is readily and easily done, and entirely covers the Men; it is to place, on the Parapet that should be raised, a Row of Gabions larger at Top than at bottom, that they may form a kind of Crenau's or Loopholes; M. *De Caligni*, Director of Fortifications, from whom I had this Idea, assured me he had used it with Success. These Gabions resemble much those Hampers or Baskets on the Rampart, which, according to the Chevalier *De Ville*, and some other Authors, were formerly used instead of our Sand-Bags, if their chief Use was not to prevent being plunged; a more essential Use than that for which Baskets was invented.

In fine, if these Means will not do, we must, according to *Vauban*, possess the commanding Ground, either by extending the Lines to it, or by good Doubts, or some other Works.

When the Line of the Front cuts one of these Emanences, and that we must consequently mount it, and descend it, was it even parallel to the Enemy, we are obliged to brisure it, in such manner that the Salient be at Top, and the Rentrant at Bottom.

The Reason of this, little different from what we have already alledged, is, that if the Line was continued strait on, we should in reality be covered in Front, but not being so on the side where the Ground falls, the Parapet of that part would not hinder our being seen obliquely.

It is seldom we project beyond the Line, in descending a Hill, yet it may happen, as in the Communication of some detached Work; the only Method I know to avoid being plunged, is to trace the Communication in Zig-zags, like the Branches of a Trench; the more acute the Angles are, the less they are subject to be enfiladed, and the shorter the Branches are, the more they are covered by the Crotchets.

V. I will add some Reflections on so important a Subject. We should, if possible, possess the Heights, was it only to prevent the Enemy from molesting us from them; yet they are not absolutely so advantageous in themselves, as is commonly imagined.

All these, in Proportion to their Height, discover at a Distance, and command the Depth of the Battalions and Columns of the Assailants. All have besides the Advantage of being secured from the Ricochet, and even of diminishing the Effect of Cannon, which, firing from a low Place to a higher, with much Difficulty enters the Parapet, which it batters obliquely in respect to its Thickness.

We should also add, that the first Rank of the Enemy being higher than the second in ascending, it is consequently the only one that can fire on the Intrenchment. These Advantages are real, but the Inconveniences attending them are more so.

It is essential here to distinguish two different sorts of Fire; the Rasant or Grazing, in this respect, is that which going in a Direction parallel to the Horizon, beats down all it meets with within its Range, and the Fichant or Plunging, that which fires from a higher on a lower Place, and only damages whatever it meets with near the Point where it falls.

This Distinction being understood, explains one part of what I woul^d say. Whatever be the Height, every Shot that falls and does not rise again, will be Fichant or Plunging, and consequently less dangerous, even supposing the Soldier to take Aim; and as it is almost impossible, let the Elevation be ever so little, to raise himself enough, it is evident that Cannon will have little Effect, and small Arms still less, and this Inconveniency increases in Proportion as the Enemy approaches.

This concerns the Plain, that is to say, what is beyond the Foot of the Hill; as to Ramps or Slopes I shall here suppose them of two different Sorts.

When they are so steep that the Enemy cannot easily ascend, and we can leap from the Intrenchment, doubtless we shall repulse an Enemy out of Breath, and probably in Disorder, with much Ease; especially if, by Imprudence, or too much Heat, they are led on too fast; but here also we cannot fire on the Slope without being greatly exposed, or even without mounting on the Parapet.

If the Slope be gentle or easy, we are less exposed, but the Enemy will march with as good Order, and almost with as much ease, as on a Level, so that we do not benefit much by it; for I am not of M. *De Flard's* Opinion, that Infantry charging from a higher on a lower place, come with greater Weight, and the Cavalry the contrary.

I believe we may conclude, that the most advantageous Heights, in all respects, are those which are steep and difficult of Access, provided they are so situated that Flanks may be made to batter what we cannot see in Front; or else those Eminences with a gentle and easy Slope, when this natural Glacis is near the Length of a Musket Range.

We cannot be too attentive in placing these Works, so that they possess the Summit of the Hill; at least we must take Care, that by the Irregularity of the Ground some Part of the Camp, or the Troops when drawn up, be not seen from without.

VI. When a Village is found within Reach of Shot, it must either be left in Rear, or fortified so as to serve as a Flank to the rest.

This is of great Importance, for if you abandon it to the Enemy, it serves them as a support, it hides their Dispositions and *Manoeuvres*, and enables them to discover yours.

When the Village is so near as to be hurtful, and in a low Ground, or too much embarrassed with Hedges, &c. to run the Line there, there is not much more to be done than making it a detached Post: As long as this Post shall subsist, it will be a

Security

Security to that part that cannot be attacked, but by exposing their Flank to the Fire of the Village: But as it is liable to be attacked, because it is detached, it will be prudent, let the Distance be ever so little, to secure a Communication, so as to prevent its being easily surrounded.

Some Redoubts are sufficient for this ; every Difficulty would then be overcome, if there did not often remain Inconveniences much more considerable : We have seen in Chap 4. that there are many Villages that cannot be fortified ; besides, such a Place requires much Work, and to guard it requires more than we are sometimes able to detach from an Army.

In these Circumstances, the common Expedient, and which appears the best, is to burn the Village; but I venture to affirm from what I have often seen, and lately at the Sieges in *Flanders*, that unless the Houses be all of Wood as in *Bohemia* and the *Upper Palatinate*, we gain little or nothing by it. What Advantage do we reap by setting Fire to a House built with Earth or Masonry? The Roof, Floors and Doors consume, but the Walls remain, and they are sufficient to cover the Enemy.

Besides, we shall find that it is not the Houses, so much as Trees, Hedges, and the Walls of Enclosures, which afford this Cover, and the Fire does not destroy them.

We should not then have Recourse to this means, but when we have time to cut down and level with the Ground all that may be hurtful; as it is rare that we do this, but when it cannot be avoided, that is to say, at the last push, it is also very seldom we reap any Advantage by these cruel Actions.

The surest Way is to avoid such a troublesome Neighbourhood as much as possible. As to less considerable enclosed Places, such as Houses or Castles, we should not hesitate to possess them, as little useful as they may be, for fear they might be hurtful, as

they are supported with little Work and few Troops. We have shewn how to defend them in Chap. 3.

VII. These last Works are so necessary, that when not found ready made, we are obliged to construct others instead of them.

One of the most essential Maxims in every kind of Fortification is, not to leave the Enemy any Cover, within a certain Extent, which Extent should never be less than that of Musket Range.

If the Line or Intrenchment is at a Distance from a Valley, too low to be seen, or any other Circumstance produces the like Effect, there must of Course be some Work added.

The same should be done to secure Communications to Heights, when we fear they may be hurtful; in fine, if we have a Dam, a Bridge, a Ford, or any other Defile before us, it must be defended near and by a grazing Fire.

Besides these detached Works, others are sometimes made, which are only separated from the Line by the Ditch: These are made to strengthen a Place greatly exposed, to possess a Point of Land, or to flank the adjacent Parts.

I shall not give the various Methods of tracing these Works, as their Figure depends on Circumstances; and as I have given so many different Schemes already, no one can be at a Loss in this Respect; I shall only add, that the most material thing is to secure the Communications, and to turn the Branches, so that they do not fire on the Lines; the adjacent Parts also must be so turned, as not to fire on the Branches.

VIII. Woods as well as Heights have their Advantages and Defects; if full of Thickets, and difficult to pass through, and not above 100 or 150 Fathoms distant, it is advantageous to the Defence of the Intrenchment, as the Enemy cannot make their Way through, without being heard by the Patroles, and advanced Guards, which gives us an Opportunity of drawing

rawing our Troops to the places attacked ; besides, they run the Risk of being charged before they can get clear, and are drawn up : In this Case the Barriers should be large, and at a little Distance from each other, so as to sally out with a considerable Front, and at many places at once.

But if the Wood be clear, high, and without Brambles and Briars, as most Firr Woods are, and are cut through by broad and good Roads, as that of *Philipsburg*, the Enemy will be able to conceal their Dispositions and Marches, to attack us when we least think of it, and to retreat when they please, without fear of being pursued, at least very speedily, provided they have taken the Precaution to line the Borders with Infantry, to favour their Retreat.

If the Wood is nearer, the Enemy have greater advantages, and if at a greater Distance, as 400 or 500 Fathoms, they cannot indeed fall on the Line, so very unexpectedly, but their Retreat will not be less secure.

In fine, when we are masters to chuse the Nature and Situation of the Ground, it is the Business of the General, rather than of the Engineer, to weigh well these Considerations.

When the Line must pass through a Wood, and by nature it is not capable of supplying the place of defence, for Reasons given in Chap. 2. cut it down to the Ground, from the Foot of the Intrenchment to the Tail of the Camp, and pile up the Fellings at 50 Fathoms in Front at least.

IX. A Morass, a hollow, a hollow Way, a Quick-sedge, even the smallest Brooks, become Objects to be regarded, either to draw some Advantage from them, or to prevent their being hurtful.

A Morass of any kind, is always an Advantage, if it extends to the Foot of the Line, since it renders it inaccessible to Cavalry at least : If it be of any breadth, and its Bottom boggy, it serves as an Intrenchment ; if it appears needful to line it with a Par-

rapet, it need only be an Epaulement against Cannon, consequently need not be flanked ; but we cannot reconnoitre and sound these Morasses too well, that we may know how far we may depend on them ; there are thousands of Examples, and I have seen Droles of Oxen crossing those with little Trouble, which were thought in the Army, to be impracticable, and which perhaps were so some Months before.

Hollows, hollow Roads, and in general, every thing that may serve as a Cover, must either be enfiladed or flanked by the Line itself, or as in Chap. 7, by some detached Work, so as to discover the Bottom. These Cavities not only cease to be hurtful, but also become useful, as they are so many additional Obstacles to the Enemy : If we find a Quick-hedge, and the Intrenchment can be so turned, as to preserve it on its Berm, it will serve instead of Pallisades.

If there is a Brook too small for an Inundation, it must be damm'd up here and there to fill it full to the Banks, and form little Pools : Or, if it runs into the Intrenchment, we must try to fill the Ditch with it. I shall not here speak of considerable Brooks, nor Rivers, having already largely treated of them in Chap. 9.

X. The different Projections of the Line, being always determined by some one of these Circumstances, it is evident we cannot always make the Fronts of an equal Length, as we are often obliged to add or diminish a certain Extent.

The Number and Variety of Methods I have given will be of great Assistance in this Respect, as they are for Fronts of 60, 100, 120 and 150 Fathoms, besides these Fronts may be diminished, provided they be done with Judgment.

If we would have Lines with Redans, 30 and even 50 Fathoms shorter, we may follow the common Method, without any Alteration, but the Brisure of the Curtain, as I have said in Chap. 6.

The Fronts of Lines with Tenailles may, without Inconvenience be reduced to 50 Fathoms, by shortening

ing the Perpendicular so that it does not exceed the half of the Front.

The Branches of the *Cremaillere*, fixed at 60 Fathoms, may be reduced to less than 30, but the Flank must in this Case be at least 12 Fathoms, and perpendicular, and its Branch must also be protected by an adjacent Fire, such as that of an higher Crotchet.

In fine, the Fronts of other Lines closed may be shortened a fourth, observing to follow the Proportions of the given Dimensions; the Figures being similar, the Direction of the Fires will always be the same.

If, to the Combination of these different Measures, we add what has been said on each particular Front, nothing need be desired more; but it must be observed, that it is much better to shorten than to lengthen them in this Case, because the Fronts generally become stronger by the first, and consequently weaker by the last.

C H A P.

CHAPTER THE THIRTEENTH.

- I. Of Profiles. II. Reflection and Example. III. Defects of Profiles too much elevated. IV. Observations on the Author's Brisures. V. Of the Height of Parapets. VI. Of their Thickness. VII. Of their Pitch or Slope. VIII. Of their interior Height. IX. Of Banquets and their Slopes. X. Of Ditches and advanced Ditches. XI. Of other Talus's, and their Berm. XII. Of the Glacis and Covert-way.

I. IT is not sufficient to give a Work the most convenient Figure in regard to the Nature and Quality of the Ground, to defend its Access; we must also know what should be its Height, and every Dimension proper for each particular Part, and this is what we comprehend under the Name of a Profile.

This is an essential point, not only in the Execution, that each part may produce all its intended Effect, but often in projecting a Figure; for if we only follow a Plan we may be led into an Error.

For Example, the Brisures I have proposed in many places, to distribute the Fire equally, and give it a better Direction, effectually procure that Advantage, and in the Plan, appear out of the Critick's reach, yet we shall find in Article 4. that they are not without Inconveniences in the Elevation.

This important part, on which we seldom sufficiently reflect, being relative to the whole, shall be the Subject of this Chapter, and the Conclusion of this Treatise.

II. I will begin by observing in general that an Intrenchment too weak, tho' well disposed in every other respect, should rather shew us the necessity of a Remedy, and the Danger, than encourage us with false notions. On these occasions the Soldier always measures by his Eye the greatness of the Obstacles the Enemy must surmount to come at him; and if they do

not appear sufficient, his Steadiness diminishes, or is discouraged : It is rare we defend ourselves as well as we might, when not supported with the hopes conquering or driving back our Adversary.

An Engineer therefore must not fear making large profiles, when Circumstances require it, and he has the means of executing it. *Vauban*, complaining of the negligence of the *French*, in his Memoirs of Sieges, would have us make two or three Banquets, to the lines of Circumvallation, and oftener three than two, that the Parapet be raised enough to be fraised, and cover the Cavalry ; and either in regard to the fortress of Sieges, or rather for the reason we shall explain, he reduced them to one Banquette only in his Treatise of the Attack of Places ; we must observe that it was by no means to save Work, since in Projects which he proposes against Succours, that is to say in cases where we are afraid of being attacked and forced, he makes the Ditches from 16 to 20 feet broad, and 8 or 9 deep.

What that illustrious Engineer tells us on this head, is too decisive to pass by unnoticed here. He says, that *Maurice* and *Frederick Henry*, Princes of Orange, applied themselves so strongly to their Lines, that they employed whole Months in their Construction, and that they made them so strong, that though they were often attacked, they were never forced ; but they also added particular Forts at certain Distances from each other, and according to the Practice of those Times they fortified their Quarters separately, and advanced Works on the most exposed Places to stop the Enemy, and thus give time to the Troops to arrive from the neighbouring Quarters to the assistance of the menaced Part : Precautions which have always baffled the Enemy's Designs, and often endangered their being beaten in their Retreat.

The Examples of such able Generals, related by an Author, will doubtless be of more Weight than what can be farther alledged.

III. Having

III. Having thus shewn the Importance of giving good Profile to Field-Fortification, we will inquire what Dimensions are most proper for them.

An Height of 9 or 10 Feet, as *Vauban* demands requiring three Banquettes, that the Parapet may cover the Cavalry, has without doubt its Advantage since such Lines may be fraised, and serve instead Epaulements, and in fine, are more difficult for the Enemy to mount: Yet this General has since fixed the Height of the Crown of the Parapet, of his greatest Profiles, at 7 Feet and a half, even where the Excavation of the Ditch would have allowed an Addition, without an Augmentation of Work: He did apparently make this Alteration without good Reason we will therefore endeavour to find them out. We cannot but improve by studying the Motives of great a Master.

We have seen the Advantages of a grazing Fire Chap 12; and that the more it is Fichant, or inclining to a perpendicular, the less hurtful it is: But it is always more Fichant in proportion to the greater Height, at least, as we observed, when the Ground we defend is not parallel to the Lines of Fire.

Every Elevation beyond * 4 Feet 4 Inches, which is the Height at which a Soldier of a middle Standing holds his Piece to fire right before him, or parallel to the Horizon, is therefore always a Defect, which must be diminished as much as possible.

Supposing on the contrary it is 9 or 10 Feet high and one Foot in a Fathom slope or plunge, the small Arms, by following this Direction, cannot reach the Ground nearer than 9 or 10 Fathoms from the Spot they fire, from whence arises a much greater Defect viz. that the Enemy will find himself covered from

* The Reader must here observe that one Foot *Paris* makes a Foot and half an Inch or 6 Lines, *English Measure*; this Difference, though inconsiderable in the Plans, is of great Consequence in the Profile.

the direct Fire, in proportion as he approaches the Counterscarp, near which he will be out of all Danger. We may indeed remedy this Defect, as we shall see, but the first always subsists, and increases in proportion to the Depth of the Ditch, which forms new Inconveniences.

As the Bottom of the Ditch is not seen direct, it is unavoidable Evil, and so evident, that it is needless to quote it, but this must be endeavoured to be remedied by the Flanks. It is not with Field Fortification in this respect, as with Places; the Ditches of the latter, if well constructed, are seen in all Parts; but this is not so with this kind of Fortification, where the Ditch is much narrower and parallel to the Master-line, and in certain places cannot be seen from any

These defective parts, in common Lines, are along the Faces of the Redans, beginning at the Intrant of the Counterscarp: The Ditch cannot be seen there but from the Extremity of the Curtain; and its plain that the Extent, which cannot be discovered from thence, not only increases by its Depth, but also by the greater Elevation of the Parapet.

These are, if I don't mistake, the Motives that induced *Vauban* to lower his Profiles; I should have been inexcusable if I had departed from the Maxims of so great a Man.

IV. This is the Place to resume my Subject, on the proposed Intrenchment. One of the Redans, always discovering the Foot of the next, according to common Method, there are not any of those dead, defective parts along the Curtain, which the measures necessarily cause in all mine.

The Defect is greater in Proportion I own; therefore it is only necessary to know, if that is as essential as it appears, or whether it is so well compensated by other advantages, as not to reject them. I shall therefore observe.

18. That

1st. That we are not commonly confined to the Attack of one Redan only, and if for Example we include them in the Attack, the two Curtains which join them, have no Protection to expect, each being engaged then too much in its own proper Defence, assist in that of another, thus it seems to be indifferent.

2^{dly}. That if the Curtain is attacked, as the adjacent Redans will infallibly be so too, each will fire directly before itself, and in this Case neither the Counter-scarp nor the Ditch will be defended by any thing; whereas by my Method, all reciprocally flanking each other, we cannot particularly defend any one, without also defending the part we should.

3^{dly}. That my Capitals are covered by many crossed Fires, that are not to be found in common Lines, and to avoid Repetitions, I must beg the Reader to collect what I have observed on this Chapter, in different Parts of this Treatise.

I shall not alledge that these dead Angles are found in Stars, and in demi-bastioned Forts, and all other Works of this Nature. However indispensable they were formerly, it is not the less a real defect; * and we should consequently avoid it, as much as possible, that is to say, without losing more than we gain by it.

Though this is a Fact, we must own all Inconvenience disappears when the Ditches are full of Water; my Schemes have at least some Advantage over this Case, and was I mistaken, I may be permitted to say, that treating on a Subject so important, so simple and yet so neglected, their Variety will always be useful, and that by inciting a Curiosity or Emulation in those that will criticise on mine, and perhaps give Birth to more happy Ideas.

V.

* We shall find, in the Treatise that follows this, a Method plain, as ingenious, to remedy such Defects. It was invented by M. De Verville, whom I mentioned in Chap. I. Article 4.

V. We will now pass over those preliminary Reflections, to the Detail of the the Profiles, our intended Subject.

Every Intrenchment of Earth, is composed of a Pl. xxxvi. Carpet, one or more Banquets, one or two Ditches, and sometimes a Berm, and a small Glacis.

We have shewn M. Vauban's Thoughts on the great Height of Profiles, and the particular Reasons had for conforming to his Opinion. I will therefore, with him, fix the greatest Elevation at 7 Feet and a half from the Ground.

Yet this must only be in common Cases; for there are Circumstances, which oblige us to raise it more; such as the Necessity of commanding the Environs, to range into some low part, or to cover a Branch, by using the Salient.

Works closed at the Gorge, joined to Lines, must be excepted from this Rule, unless when so situated, to command the rest, which should be at least by two, or three Feet.

If we recollect the Nature of the Inconveniences which oblige us to confine the Profiles to this Height, shall find, that they are not always united. I will explain myself better by examples.

When we elevate a Front but 4 Feet, or thereabouts, above the Ground we would command, it is in vain we batter it with a rasant Fire, though the Defect of the dead Part increases: on the contrary when it is necessary to raise a Salient to a certain Height, to cover a Branch, provided the Rentrant preserves a determined Height for the Breadth of the Ditch, the Fire becomes more fichant towards the flanked Angle, without the Ditch being less defended.

We may in the first Case, reject the Brisures, if it be thought necessary; that will be so much gained, especially if we can find any Means of distributing the fire, as well without them; in respect to the second Case, that is of Fires too fichant, or plunging, that Defect alone is the Reason which prevents our giving

ing

ing the Profile that Height we would to Work without Flanks, or to those that have them too oblique, which consequently do not defend their Ditch

I do not here speak of the Cover the Enemy finds against a direct Fire, by approaching a Work too much elevated, because that is easily remedied, I have said before.

In fine, a Parapet should never have less than Feet Elevation above the Ground, without which it only covers in part those that are behind it; thus the Difference, between the highest and the lowest, reduced to one Foot and a half.

VI. The Thickness of the Parapet varies much more than the Height. In regard to this, the Design and Nature of the Work must be considered. Three Feet is enough for that which is not exposed to Cannon, for Example, the Intrenchment of a grand Guard; four Feet and a half is sufficient for Works that cannot be battered but at a distance; the rest have 6 or 8, and even 12 Feet is allowed for intrenched Camp Heads of Bridges, Redoubts, and other Pieces, intended to stand a long time, or that may be exposed to a brisk Fire of Artillery, or a long Attack.

The Thickness is not exempt from a Defect, but it is of so little Consequence, it is scarce worth mentioning, it consists in unavoidably shortening the Branches.

I do not here speak of the Reduction of the Sides of Polygons, inscribed in other similar Figures, which I mean is more essential, at least in the rasant grazing Defence, since it diminishes the Salient, and consequently the Protection of the Flank: We must consider that what we gain by the Rentrant is no indemnification in this Respect, since it is visible, that when the Flank is perpendicular, as we suppose, the Part it should graze.

The last is, strictly speaking, a great Defect; we may correct it in bastioned Lines, by advancing the

Curtain

Curtain to this Intersection, and more easily yet in every Case, by rounding the interior of the Parapet of that Part, if so scrupulous an Exactness was not a fault in Practice, where too minute an Attention to trifles often creates a Negligence in more essential things.

VII. When we consider that the Plunge or Slope of the Parapet commonly determines the Direction of small Arms, it is obvious, in whatever Manner it is traced, it is never without Inconvenience; for we do not discover the Counterscarp at the Bottom of the Ditch, but in Proportion as this Slope is great, and Proportion to its Increase, its Direction varies from the rafant Line.

These Objects being incompatible, all we can do, is to find a Mean between them that shall be most proper.

I think this has been sufficiently treated of, in the Treatise of the Attack of Places; we there find Parapets of 6 Feet thickness, which have one Foot and half Slope or Plunge: I own this appears excessive to me, not only because the Fire becomes too fichtant by plunging, but also it weakens the Crown, and by following this Direction the Soldier will discover himself too much, and, as we shall find in the following Article, much more than he should do.

I would not have above 12 or 15 Inches Slope in a Parapet, to which I will add this Observation.

The highest Profiles commonly having the deepest Ditches, this additional Height and Depth increase, the one the Cover in Front on the Counterscarp, and both, that in the bottom of the Ditch.

We must therefore give the least Plunge to the weakest and weakest Parapets, and increase the others in Proportion to their Height, which is not at all inconvenient, for besides their greater Thickness, the top cannot be battered but horizontally, and consequently with little Effect.

On this Account I find the Slope at one Foot in a Fathom for Profiles six Feet high, and an increase of one Inch in every half Foot, giving 13 Inches to those of 6 Feet and a half, 14 to those of 7 Feet, and 15 Inches to those of 7 Feet and a half.

Thus supposing the Ground level, these different Fires fall equally on the Counterscarp at 6 Fathoms from the Point they depart, and at a little Distance from each other in the bottom of the Ditch.

As to Profiles of an extraordinary Elevation, the greatest Slope, that is 15 Inches, appears to me sufficient.

VIII. Four Feet and a half is commonly allowed to the interior Part of the Parapet. It is a Custom so generally followed, that it seems established as a Maxim.

This Rule would have been less followed had it been more strictly examined; it is good indeed for the Construction of Places whose Parapets sink in Time, and have also much less Plunge, or Slope, but Circumstances varying, it is plain that it cannot be proper here.

I know by myself, that a Man of 5 Feet 6 Inches standing as he should do, the left Foot 18 Inches distant from the Upright of the Crown of a Parapet 4 Feet and a half high, which 18 Inches is the common Slope or Talus, fires with more ease horizontally, than if it had a Plunge of 8 Inches in a Fathom.

Few Soldiers being of this Standard, it is not surprising that so many Shot are lost in the Air.

There is but one Remedy for this; it is not only to diminish this Height, but also to diminish it in Proportion to the Plunge, for this Circumstance is essential, that he should be near 6 Feet high, to fire over a Parapet 4 Feet and a half high, and 18 Inches Plunge in a Fathom, such as we have spoken of in the preceding Article.

I therefore think that a horizontal Parapet, such as those of some Communications, and other Works,

raised more than 4 Feet 6 Inches from the Ground, could not be more than 4 Feet 4 Inches, and in regard to others, they should be lowered in a Proportion of 4 Inches in a Foot Plunge.

It will without doubt be objected, that the Soldier will be much more exposed; I acknowledge it, but what service is a Slope we cannot make Use of? besides, a Soldier on these Occasions naturally stoops, that more than his Head is never above his Fire-k.

Baskets, or small Gabions, such as I mentioned in article 4. of the preceding Chapter, would be of great Use here, since they remove all Difficulties, at least, in respect to the Fire of small Arms.

X. The exterior Height of the Parapet being regulated by the interior, and plunge, there is nothing to be said on that Head.

A Man in the Attitude of Firing does not possess much more Room than two Feet; three Feet is then sufficient for the Banquette, yet we commonly allow four and a half, that a Soldier may stand behind, or in the Rear of him that fires.

This Breadth is allowed from the Foot of the Palisades when there are any.

It would not have the Banquette more than three Feet high, it is much better to make two of two Feet than one of four, because a Slope, when steep, is always easier to mount when so short.

Three Feet at most is sufficient for the lower Banquettes, they not only serve as Steps, but also to draw up the Soldiers on, to relieve those that line the Parapet.

The Slopes of Banquets, may, also, be regulated to fit their Height; when they are only one Foot, the 8 Inch Slight Slope is enough, as they have only to step a little higher on one of two Feet; I allow to the Base Height and a half, and two Heights to those that are raised 2, or 3 Feet.

In narrow Places, to manage the Ground, we may form Steps with Hurdles 12 Inches high, and 9 broad which serve instead of a Slope.

X. The excessive Breadth of the Ditch, if it is full of Water, creates a Defect in durable Fortification, (or that of Places) which is, that Batteries on the Crown of the Glacis, or on the Terreplein of the C^rvert-way can, without plunging much, sap the R^oof the Revetement or Face of the Wall: But there is no reason to fear that, in the kind of Fortification we are here treating of.

The greater the Breadth, the more Advantage we reap here; the Enemy is more exposed on the Counterscarp; the Length of the dead, or undefended Parts, which we have spoken of, diminish; and if the Ditch is to be filled up, the Work becomes more tedious, and consequently the Enemy are exposed much longer to a Fire very terrible because of Proximity.

We need not fear making the Ditch too broad, yet it must be regulated by the Time and Number of Workmen allowed us, and also by the Quantity of Earth we have Occasion for.

It is not so in Regard to its Depth: As in flank Works it naturally increases the dead Parts, I would not have it exceed 7 Feet and half. As to Works not flanked, where no Protection is to be drawn but from the Parapet, also in Ditches full of Water it cannot be too deep, since it always is an Addition to the Difficulty of Access, without any Inconvenience.

On the contrary, I think the Depth should not be less, if possible, than 6 Feet, which must be preferred to its Breadth, otherwise the Enemy may easily leap over, or too easily fill it up.

The Distance of the advanced Ditch from the Counterscarp is regulated by the Precautions mentioned in Chap. 2. As we have seldom Occasion to draw the Earth taken from it, we make it small, and fit it to the little Glacis beforementioned. I would have it

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opes of this Ditch, dry or wet, meet at the Bottom; the first Case the Enemy cannot stand there, and the other, it will not be less difficult to pass: Their depth must at least be 6 Feet, and their Breadth 7, that they may not be easily leaped over.

XI. Talusses or Slopes depend on the Consistence of the Earth, but though we cannot determine anything positive in this Respect, it will be useful to lay down a general Rule to avoid errors as much as possible.

The nearer the Soldier is to the Crown of the Parapet, the better he can follow the Direction of the Scarp or Plunge; therefore the Inside will be better to be quite Perpendicular, but as this is seldom possible, we give it as little Talus as possible, which is commonly about one third of the Height. *Vauban* gives the Slope of the Scarp and Counterscarp, one third of the Breadth of the Ditch; I do not see his Reasons for this, it is evident that the nearer these Parts approach a Perpendicular, the more difficult they are to ascend and descend; it is therefore by the Nature of the Ground, and not the Breadth of the Ditch, that the Slope must be regulated.

In sandy Ground the Scarp must consequently be a little steeper than in a Foot Talus; but with strong and bold Earth, two Thirds, or even half may be sufficient.

We cannot give it less, because this part supporting the whole Parapet, may otherwise run the risk of falling down, but as the Counterscarp is not in the same situation, we may scarp it as much as possible, especially when the Work is to subsist but a few Days.

I only speak here of dry Ditches; when they are full or full of Water, these Slopes must not be so steep as to allow for the Waste made by the Water. In

A Treatise which shall soon follow this, we shall find that there are more Precautions to be taken when the Ditches communicate with running Water.

We sometimes find light and poor Earth, which cannot be used without Danger. In this Case we

must not only increase the Slope, but also leave Berm of 2 or 3 Feet between the Slope and the Foot of the Parapet, which Berm must be rounded, that the Enemy may not halt there, and take Breath.

XII. I have in many Places in this Chapter observed, that in Default of giving all the necessary Plunge or Slope to the Parapet, the Enemy are exposed to a direct Fire, in Proportion as they advance to the Counterscarp: so essential a Defect, especially in Works without Flanks, did not escape *Vauban*; he remedies this, by forming of the remainder of the Earth a small Glacis, which can be mounted, without the Enemy losing this Advantage.

As simple as the Construction of this Work is, it requires some Attention; If the Glacis be too high, serves the Enemy as a Cavalier of the Trench, to plunging; if it is too low, it does not produce, desired Effect.

Vauban seems to have fixed this Height at 5 Feet and a half below the Crown of the Parapet. We should never give it more, especially if we follow his Profiles, since the summit of the Glacis is to be on a Level with the Banquet; as to diminishing that is regulated by the Direction of the Plunge, the only Object being to discover the Enemy entirely, at least lower than the Waist, when he is on the Edge of the Ditch; I say below the Waist, that is about two Feet from the Ground, because they commonly sink themselves on these Occasions.

The same must be observed for the Slope; that it must be such, that there be no part where a Man is not seen entirely, or at least at that Height. Consequence of these Maxims, the Glacis is perpendicular without being too high, it is in a Line with the Plunge, or Slope of the Parapet.

This Glacis has besides this, two other Advantages, one in adding to the Depth of the Ditch, by rais-

the Counterscarp, the other, in partly covering the Work from the Fire of Artillery.

We sometimes make a Covert Way to Redoubts, Heads of Bridges, and other Works depending only on themselves, if their small Elevation, does not appear an insurmountable Obstacle : In this Case I would link the Counterscarp, to preserve the necessary Command to the Crown of the Work. This Loss seems more than compensated by this rasant, or grazing Fire, which I draw from the Covert Way, and which cannot be obtained from the Parapet, before the Enemy are on the Glacis.

The Designs here referred to will explain my Pl. xxxvi. Thoughts ; it will still be better if the Crown of the Glacis be level for some Feet, as the Fire following this Direction in a flat, and even Ground, will be the most advantageous in every Respect.

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REMARKS

ON A

NEW SYSTEM

OF

FORTIFICATION

PROPOSED BY

MARSHAL SAXE

In his Reveries or Memoirs on the Art
of War, 1757.

C O N T E N T S.

C H A P. I.

Of the Construction of this New System.

C H A P. II.

Of the Attack and Defence of the Covert-way, Lunettes and Counter-guard.

C H A P. III.

Of the Attack and Defence of the Ravelins, and the Body of the Place.

C H A P. IV.

A Comparison of the Advantages and Defects arising from this System.

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THE Eagerness with which the Publick received the Keveries or Memoirs of Marshal Saxe, is a certain Token of the high Esteem they still have for the illustrious Author; and the many Editions that Work has undergone is a great Proof of its Goodness. The Marshal, full of new Ideas, has embraced the whole Science of War, and has shewn a profound Knowledge of the Antients and Moderns; and whilst by proper Dispositions he teaches to conquer, which inevitably exposes the Soldier's Life, he is particularly attentive to every Thing which may preserve his Health, well knowing that on this depends the Success of the Campaign: He then enters on several Discussions on the Methods of cloathing, subsisting and encamping the Troops, &c. which contain many Novelties of Consequence, and shew his great Foresight in the Art of War.

The Art of fortifying Places could not be forgot by so great a Man, and as he has shewn the same critical Spirit in his Enquiries into this Science, as he has done in his other Researches, we may conclude that the Defects and Imperfections we meet with in the Construction and Disposition of the Works, could not have escaped him. Thus may we say, that the System of Fortification has taken a new Face in his Hands. He has introduced Principles heretofore unknown, and has rejected others which were ever regarded as most essential to the Defence; and from these new Maxims

P R E F A C E.

ims he draws a Method of fortifying, entirely new, which, according to him, so much exceeds the common Method, that he ventures to say, " that such a Fortress would soon quench the strong Desires that at present prevail for Sieges." This Declaration merits the greater Confidence, as the Marshal does not adopt the Invention of this System, altho' there is room to think he has much contributed to its Perfection.

Discoveries which promise such considerable Advantages deserve to be more largely treated of, than the narrow Limits of a Memoir would permit, and that is the Design of these Remarks. We have there shewn the Principles of this new System, and the different Effects resulting from them; we have compared the Advantages and Disadvantages; and if at any Time we have differed from the Marshal's Opinion, it was only in Cases where we were guided by Experience, that invincible Judge in this Subject, and whose Decisions are superior to any other Authority whatever.

CHAPTER

CHAPTER THE FIRST.

Of the Construction of this new System.

W HATEVER Progress has been made in Fortification, it is far from being brought to that Perfection that might be wished, or that the great Reputation of Messrs. *Vauban* and *Coeborn* gave room to expect. The Facility with which the Enemy ruin the Defences of the Place, and dismount the Batteries, the Difficulties the besieged meet with in covering themselves in their Works from the Enemy's Fire, the Impossibility of supporting the Outworks when separated from the Body of the Place by wet Ditches, are Defects too common in modern Fortification, and the Reason why the best fortified Places can make no Resistance any ways equal to the Expence of their Construction. This was Marshal *Saxe*'s Opinion, which he proved by Experience; persuaded on the other Hand, that a Science, which has so great Share in War, and often decides the Fate of Nations, was too important, not to merit his Attention; he has endeavoured to correct these Faults, and finding his Ideas agreeable to the Maxims of the respectable Author whose System he gives us, he has without hesitation adopted, and enriched it with many new Inventions.

To remedy the first Defect, and prevent the Enemy's ruining the Defences, M. *Saxe* thought it necessary to change the established Maxims of Fortification, and reject the old Method of elevating the Works. In the common Method of fortifying, they form a kind of Amphitheatre, rising one above another, in Proportion as they are distant from the Covert-way, by which Disposition they are all exposed at

at the same time to the Cannon of the Enemy. He does not raise the Body of the Place above the Out-works, and covers both by a Work more raised, which surrounds them both, by which the Enemy can see no more of the Fortification than that Work and the Covert-way.

By this Method the different Outworks, such as Ravelins and Counter-guard, form each, as well as the Body of the Place, a separate Enclosure, defended only by its own proper Front, and not exposed to the Cannon of the Enemy, until they are Masters of the Work before it; by which they are able to oppose new Works to the Enemy in proportion as they advance, which they could not see before, much less have ruined.

The second Point, which regards the Security of the Troops in the Works, is at present of great Consequence, and difficult to execute, because of the numerous Artillery with which Places are attacked, and particularly on Account of the Ricochet, which batters Works in Flank and Rear; to prevent this, M. Saxe has found no better Means than that of Traverses, with which he not only fills his Covert-way, where it was customary to have some, but also the Terreplein of all his Outworks, so as to take up one third Part of them; as their Destination is only to cover Troops, they have neither Parapet nor Banquette, as in modern Fortification, where they are intended to defend the Entrance of the Covert-way; but as his System is quite different from the modern, that is not the Design of them here.

This Disposition of them certainly hinders the Effect of the Ricochet, for only two thirds of their Shot can take Place, and they are immediately stopped, and cannot be hurtful but in the Distance of 4 or 5 Fathoms.

A free and easy Communication is essential to the Defence, this Maxim has never been disputed, but hitherto little regarded in Practice, and the Commu-

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ication of Outworks in wet Ditches, is attended with many Difficulties, that as soon as the Enemy have found their Batteries on the Crown of the Glacis, they cannot support an Assault, and must be abandoned as soon as the Enemy have compleated the Passage of the Ditch. This Defect could not escape the Marshal, he foresaw all the Consequences, and to remedy them, has followed a Method quite foreign to the practice of all modern Engineers; they thought nothing better could be opposed to the Enemy than wet Ditches; not one has neglected to use them in surrounding the Outworks, as well as the Body of the Place, when the Situation permitted. M. Saxe thought otherwise, like an Officer that knows the Importance of a Post defended by a good Body of Troops, supported by another in Case of Need, which Post may be reattacked, if obliged to abandon it, while the Enemy can only enter it, by an Opening, as difficult as that of the Passage of the Ditch.

The dry Ditch which the Marshal proposes between the Body of the Place and the Outworks, procures all these Advantages, establishes a sure and easy Communication, and serves as a Place of Arms to a large Body of Troops, which, by Means of the interior Salus of the Outworks formed in a Slope, can assist those that defend the Breach, and enables them to dispute the Ground Inch by Inch, and to throw Obstacles in the Way of the Besiegers, which they will have the more Difficulty to overcome, as the Besieged will always be more numerous, and have nothing to fear from their Batteries.

Having thus shewn the Motives which induced the Marshal to introduce new Maxims, and change the Disposition of the Works, we will see by what means he attains his Design.

Hitherto Engineers have applied all their Attention to the Construction of the Body of the Place, not only to find a true Proportion for all the Lines, and to make those that were to flank the rest as extensive as possible,

possible, to hide them from the Enemy, and prevent their being battered. This has produced so many Systems, that they equal the Masters in this Art: Their Schemes for hiding the Body of the Place, and keeping the Enemy at a Distance are more mutual, and may nearly be reduced to the Half-moon and Covert-way. Marshal *Saxe* takes a quite different Method; his greatest Defence consists in his Outworks, and as the Body of the Place is not exposed to the Enemy's Fire, until they are Masters of the most advanced Outworks, he thought himself not obliged to confine his Ideas so close to the Maxims of the Art, and the Precautions they direct. In the Octagon which he proposes for an Example of his System, the exterior Polygon AB is but 70 Fathoms; the Bastions are small, the Flanks only 8 or 9 Fathoms, without Brisures or Orillons; the Faces 17 or 18, the Gorges 14 or 15 at most; the Body of the Place is raised 2 or 25 Feet from the Horizon; but what is very remarkable is, that behind its Terreplein which is 10 Fathoms wide, the Marshal makes a Cavalier, parallel to the Curtain, with a Terreplein 5 Fathoms, and a Parapet surrounding the interior of the Body of the Place; its Height is above 60 Feet, and under it are constructed Casemates, to lodge the Garrison in, secure from the Enemy's Fire.

The dry Ditch, which separates the Body of the Place from the Outworks, is sunk to the Level of the Water, and is only 3 or 4 Fathoms wide before the flanked Angle of the Bastion, it widens as it approaches the Curtain, where it forms a Place of Arms, large enough to contain a great Body of Troops in Battalion to defend the Breach, and oppose the Enemy's Legerdemain in the Outworks.

As the principal Design of this System is to prevent the Enemy from discovering the Works, but as they advance in the Attack, it is plain the Outworks must not consist in detached Pieces, as common, for the

would not answer the End, but must form so many Enclosures, in order to cover what is behind them.

On this Scheme, the Marshal constructs a Work ^{PL. I.} F before each Polygon, which he calls a Ravelin, little different from those now in Use, only their Faces are prolonged to within A, or 5 Fathoms of the flanked Angle of the Bastion, where they join each other, so as together, to form a continued Enclosure, entirely covering the Body of the Place.

These Ravelins are raised 24 Feet, or thereabouts, ^{PL. II.} above the Horizon, with a Terreplein 7 or 8 Fathoms ^{Nº. 11} wide, furnished with Traverses at four Fathoms from each other; their interior Talus is formed in a Slope for the Reasons above.

The Capital Ditch surrounding these Works, is traced in a different Manner from the common: The Marshal observing that Ditches drawn parallel to the Faces, as was the Custom, had one great Defect, that when the Enemy was lodged on the salient Angle of the Ditch, they found abundance of Room to erect their Batteries on; he therefore makes his but ^{or 5} Fathoms wide before the flanked Angle of the Ravelin, and 15 or 16 before the Rentrant, by this Method the Besiegers find but little Room on the Salient Angle, and are so much exposed to the Fire of the Place, that they will find it very difficult to lodge themselves there.

Beyond this Ditch is another Enclosure, or Enceinte C, which he calls a Counterguard, being only 3 or 4 Fathoms broad, surrounding the Ravelins as well as the Body of the Place; this Work being raised more than 30 Feet above the Horizon, and the others but 24 or 25, it covers them so well, that they cannot be seen from the Country. The Passages H serve ^{PL. II.} for a Communication to the Covert-way and Lunettes; ^{Nº. 2.} the Terreplein of this Work is also filled with Traverses at 4 Fathoms distant.

Under the Rampart of the flanked Angles of this ^{PL. II.} Work are Casemates open to the Ditch of the Ra- ^{Nº. 3.}

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velin, they serve as a Retreat to floating Batteries, * invented by the Marshal, with which he not only defends the Ditch, but also the Counterguards and Lunettes, bringing them through the Passages before-mentioned.

Pl. ii.
N°. 2, 3. The Construction of the Counterguard is entirely new, or rather an Imitation of the antient Method of the Gauls, as described by † *Julius Cæsar* in his Commentaries. They are built of Beams crossing each other at 4 or 5 Feet Distance, covered with Earth to a certain Height, over that another Row of Beams,

* Vide Plate xxii. of his Memoirs, and Plate xi. of Essay on Fortification.

† 23 Lib. 7. de Bello Gallico.—Muris autem omnibus Gallicis hæc sere forma est: Trabes directæ perpetuæ in longitudinem, paribus intervallis, distantes inter se binos pedes, incollocantur. Ea revincuntur introrsus, & multo agere vestiuntur. Ea autem, quæ diximus, intervalla grandibus in fronte fam effariuntur. Iis collocatis, & coagmentatis, alias insuper ordinatæ adjicuntur, ut idem illud Intervallum servetur, neque inter se contingant Trabes, sed paribus intermissæ spatiis, singulae singulis axis interjectis arte contineantur: Sic deinceps omne Opus constet, dum justa Muri altitudo expleatur. Hoc quum in speciem varietatemque Opus deforme non est, alternis trabibus axis, quæ rectis lineis suos ordines servant, tum ad utilitatem & defensionem Urbium summam habet opportunitatem, quod ab incendio lapes, & ab Ariete materia defendit, quæ perpetuæ trabibus pedes quadragesimos, plerumque introrsus revincta, neque perrumpi neque distrahi potest.—Most of the Cities of Gaul build their Walls after the same Manner; they lay along on the Ground two strait Beams at two Feet distance, parallel to each other which they bind together on the inside, and cover the outside with Earth. The Interstices between the Beams they fill with large Stones, cemented with Mortar, over which another Row is carried on in like manner, that when the next superior Beams are laid on them, they may not touch the inferior, but at uniform distance be preserved by an equal and artificial layer of Wood and Stones, continuing the same method, till they have raised the Wall to such a Height as they think convenient; This Way of Building is as useful as beautiful; for as the Variety and equal Intermixture of the Materials is pleasing to the Eye, so the Stone is proof against Fire, and the Beams against the battering Ram, for being fastened within the Town by continual Planks of 40 Feet long, they can neither be broke through, nor disjoined.

and so on, to the intended Height. The Marshal's Method differs from the Gauls, in giving a Talus to the exterior Side, and covering it with Sod, whereas the Gauls raised them perpendicular, and filled the intervals between the Heads of the Beams with large stones.

The Ditch which separates this from the Covert-way is constructed like that of the Ravelin, and is only 4 Fathoms wide before the Salient.

The Lunettes I, serve to cover the Rentrant of the Counter-guard, and defend its Ditch before the Salient Angle; one third of the Face is retreated, and serves as a Flank, the Height of this Work is not determined, but probably it does not much exceed that of the Covert-way, it is separated from the Counter-guard by a Ditch only 3 Fathoms wide.

The Covert-way K is 5 Fathoms wide, without Inchement or Place of Arms in the Rentrant, but garded with Traverses, of which there are 5 on each branch; at 4 Fathoms distance from each other, its parapet has a Glacis added to it as usual.

This is the new System, so entirely foreign from what has been thought of in this Art: We will now deavour to shew if the proposed Method enables the besieged to hold out longer, without exposing them to new Difficulties, which, though of a different Nature, may be no less inconvenient than those deavoured to be avoided.

CHAPTER THE SECOND.

Of the Attack and Defence of the Covert-way, Lunettes, and Counter-guard.

Having shewn the Marshal's new System of fortifying, and the Construction of his Works, we will now examine their Effects, and the Advantage which may be drawn from them for the Defence.

As on one Hand, the Besiegers can discover none of the Works of the Place but the Covert-way, and the first Enclosure formed by the Counter-guard, the Besieged cannot, on the other Hand, dispute their Approaches, nor prevent the Construction of their Batteries but with Cannon placed on the Covert-way.

Hitherto we know but of two Methods used of serving Cannon in that Work; one, to make Elevation of Earth in the salient Angles to fire à *Barbette*, the other to draw them back to the Edge of the Ditch and, being elevated, throw the Balls over the Palisades; this is very uncertain and of little Effect, because we do not see the Object, and always fire at great Range; the other is very dangerous, because the Cannon and those that serve them are exposed to the Enemy, on which Account they can only be used in the Night.

Pl. ii. To these two Methods the Marshal has added a third, which unites the Advantages and corrects the Defects of the other two; instead of Elevations of Earth, he makes scaffold Platforms, strong enough to support the Weight of the Cannon, and to resist the Effort of the Shock; they are raised about 6 Feet from the Covert-way, and within 2 Feet and half of the Summit of the Parapet, their Length is 24 Feet, that of the Platform 10, and the rest is made in a Slope which terminates 7 or 8 Feet from the Side of the Ditch; these Cannon are mounted on Ship-carriages when they are fired they not only recoil the Length of

the Platform, but also down the Slope to the Covert-way, where they are loaded, covered from the Fire of the Enemy, they are then drawn up by a Machine, which is not sufficiently expressed in the Plan to form any just Idea of. *

With these Batteries the Marshal proposes to ruin those of the Besiegers in the Day, and to fire with Cartridge on the Front of the Trenches in the Night. As this Scheme is entirely new, it merits some Reflection. While the Cannon is on the Platform, it is exposed to the Enemy's Sight, as well as the Gunner who must fire it, for which Reason it will be very dangerous to take as much Time as needful to point it well, when the Trenches are advanced within Musket Shot. Again, these Pieces cannot be more than Six Pounders, (for without speaking of the Shock, the Scaffold and Cords must sustain, to stop the Cannon at the Bottom of the Slope, and for which Use they cannot last long;) two or three Men only, which the Marshal allows to serve each Piece, cannot draw them to the Platform, if they are of heavier Metal, unless the Machine was very compound, which would diminish the Briskness of the Fire, and more expose the Cannon, as it would mount so much the flower. It will not then be possible to fire with proper Exactness, and much less to ruin the Enemy's Batteries with pieces of such a Bore. The first of these Defects is common to the Amusettes, a kind of Culverine of half a Pound Ball, of the Marshal's Invention, which uses instead of small Arms, and places them in the intervals of the larger Cannon; we shall not therefore be able to keep such a continual Fire on the Enemy's embrasures, nor prevent them from serving their Cannon, as he says in Page 146 of his Reveries. If these Remarks are just, it is certain the Besieged cannot well dispute the Approaches of the Enemy, nor

Vide Pl. xxiii. of his Reveries, and Pl. xiii. of Essay on Fortification.

Vide Pl. v. of his Reveries, and Pl. xii. of Essay on Fortification.

the Construction of their Batteries, by the Cannon of the Covert-way : Yet it is the only Work they can be plaid in ; for the Terreplein of the Counter-guard is too narrow, and its great Elevation forms a second Obstacle, nor can Cannon be transported there without the Help of some Machine, which would not fail meeting with great Difficulties in the Execution. It must be further observed, that if these Batteries have the Effect the Marshal proposes, the Enemy would not be incommoded as soon as they had reached the Foot of the Glacis of the salient Angle ; the Branches of the Covert-way command them too obliquely, and the Cannon, as well as the Amusettes, can only fire right before them, unless their Directions were changed, on the Top of the Platform, which, for the Reasons already given, would be very dangerous, the Besiegers have therefore no other means of oppressing them, but by Sallies.

Sallies, which all Engineers have hitherto always managed with the utmost Care, seem to have been entirely neglected by the Marshal. There are Places of Arms in the reentrant Angles, where Troops can be assembled for Expeditions of this Nature, besides, the Traverses and Platforms in the Covert-way cut off all Communication from one Branch to another, and if the Besieged, notwithstanding these Obstacles, should have made a Sally, they would be disengaged in their Retreat, because they can only be protected by small Arms from the Counter-guard, too high, and in some Places at too great a Distance, to do any Execution.

The Approaches being pushed to the Foot of the Glacis, the Besiegers may either attack the Covert-way by Assault or Sap, as this new Scheme gives them great Assistance ; for having razed the Crown of the Glacis by Cannon, and broke the Pallisades, nothing prevents their advancing even on the Platforms, and tumbling down into the Ditch, all they find between the Traverses, which are only those few that serve

the Cannon, since there is no room to post other Troops there; besides, the Traverses continued to the very Edge of the Ditch, cut off their Communication, and consequently deprive them of the Power of assisting each other. For this Reason, surprises are to be feared, as much as Assaults, and by either Method the Enemy may sometimes make themselves Masters of it, without more to do.

If the Enemy attack by Sap, they will make Cavaliers of the Trenches A to lodge themselves in the salient Angles B, they will afterwards continue their Lodgement along the Pallisades, and drive the Besieged from the Covert-way without much Trouble, because they have no Intrenchments in the reentrant Angles, and will not dare to mount their Batteries again. The Lodgement being finished, they will pierce the Parapet, and enter the Covert-way wherever they please; the Traverses will be of great Assistance to them, since they not only shelter them from the Fires of the Counter-guard and Lunettes, but also prevent the Besieged from coming at them, and disturbing them in their Works by Sallies, so that it will be impossible to dislodge them, when once they are posted there.

Masters of the Covert-way, the Besiegers will construct the Batteries C to open the Faces of the Lunettes D, which they should have defaced before they attack the Counter-guard, because their Flanks defend the Ditch before the salient Angles.

As the reentrant Angle of the Tenaille, which the Counter-guard forms before each Polygon, is too open, for the two Branches to flank each other reciprocally; and besides, as this Work is not proper for Cannon, the Marshal, to supply this, introduces * floating Batteries, from which he promises great Advantages. Page 44 of his Memoirs, he say, " Suppose the Enemy attack me, they will take my Covert-way,

" vert-way, and ruin the Defences of my Lunettes
 " as usual; while I have the Casemates in the ren-
 " trant Angles * of my Counter-guards free, how
 " will they pass the Ditch to come at my Counter-
 " guard and Lunettes? they will ruin them say they,
 " that is not easy, if not to say impossible; for they
 " can only place two or three Cannon on the saliant
 " Angle of the Counterscarp, and drawing my Floats
 " from my Casemates, I fire continually with 100
 " Pieces of Cannon, and provided I have but the least
 " Opening, I can discover the saliant Angles of my
 " Counter-guard Lunettes from the Bottom of the
 " Ditch; will they dare to make their Gallery ex-
 " posed Night and Day to so terrible a Fire, which
 " they can neither see nor dismount?

Let us now suppose that the Casemates for the floating Batteries are made under the Terreplein of the saliant Angles of the Counter-guard, and their Entrance into the Ditch of the Ravelins, so that the Floats must come into the Ditch of the Counter-guards by the Passages E, and afterwards be drawn up, so that they may flank the saliant Angles of that Work and the Lunettes. Thus it is plain we cannot use 100 Pieces of Cannon here, as each of them is mounted on a Float about two Fathoms square, unless they would cover the Ditch entirely; but even then they will not be able to see with them to the Bottom of the Ditch of the saliant Angles of the Counter-guard and Lunettes, as he pretends. All Things considered, there is not Room to place more than 16 of these Floats before each Polygon, which being drawn out by the Passages E, must be ranged nearly in the Manner marked in F, to flank the saliant Angles of these Works, and to defend the Passage of the Ditches; thus we may judge to what this terrible Battery of a hundred Cannon is reduced.

* This is a mistake of the Press, and is committed in all the Editions; for the Casemates are in the saliant Angles.

Let us yet examine, if the Besiegers cannot render these Floats quite useless. The Passages E, by which they are to come into the exterior Ditch, are only 3 Fathoms broad; the Counter-guard is about 40 Feet high from the Surface of the Water; by raising Batteries in the reentrant Angles of the Glacis, it will be easy to batter the Counter-guard on both Sides the Passage, and the Rubbish, considering the Height of the Work, will choke up a Passage so narrow that not one Float can come out, and even supposing they were out, a Detachment of Infantry, placed in the Lodgment of the reentrant Angle G, will receive them first at their coming out with a Discharge of small Arms, and prevent them being drawn up opposite the salient Angles, for that requires time, and must be done under a very smart Fire, and at the very muzzle ends. To prevent the Floats of the other fronts from being drawn to that of the Attack, the Enemy need only establish the like Posts in the salient Angles where the Lodgment will be prepared to their Hands by the Traverses.

By this Detail, we may easily judge that the Passage of the Ditch of the Lunettes cannot be much disputed, and as it is but 7 or 8 Fathoms broad in the place where the Enemy will make the Bridge, they will compleat it in a very little Time, and the Besieged must of course abandon the Works, if they are not willing to be cut to Pieces, as their Retreat must be made by the above Passages, and consequently in a very dangerous Manner.

The Besiegers will construct the Batteries H in the nearly Lunettes, which the Besieged can only oppose by small Arms from the Counter-guard, too high to do any execution: These Batteries being finished, the reentrant Angle of the Counter-guard will soon be opened, the Ditch which in this Place is but four Fathoms wide, will be filled up with the Rubbish, and the Passage made without one Fascine being used by the all the Enemy.

During

During this, the salient Angle of the Counter-guard being battered by the Batteries I, and as the Besieged will find the same Impossibility to defend the Passage of this Ditch, half filled up with Rubbish because it is so narrow, it will soon be perfected, and the Lodgment established at the Foot of the Breach without being opposed in any Manner by the Besieged.

Things being brought to this Point, without Doubt the Besieged will be obliged to abandon the Counter-guard, since they cannot maintain themselves there in Case of an Attack, because it is so narrow and encumbered with Traverses, and on the other Hand its Elevation renders the Retreat extremely difficult; for it can only be made by Stairs in the Terreplein which may be easily ruined by Mines, and would consequently deprive the Besieged of the means of retreating, if they delayed ever so little.

This is all the Enemy need do, to become Master of the Covert-way, Lunettes and Counter-guard. In the next Chapter we will shew the last Operations of the Siege to the taking of the Place.

CHAPTER THE THIRD.

*of the Attack and Defence of the Ravelins, and the Body
of the Place.*

Before we speak of the Enemy's Lodgment and Batteries in the Counter-guard, we will examine its Construction. We have seen what the Marshal proposes, but as his Scheme is only to be executed in a Country full of Wood, such as Poland, it is to be supposed that on every other Occasion where Forts were to be constructed, the Marshal would employ more solid and durable Materials than Wood; which decaying in Time, whether it be exposed to the Air or covered with Earth, cannot be durable, especially in the Casemates, since it is impossible that simple Piles, planted in the Ditch without any more precaution, can long support so great a Quantity of Earth as they are loaded with, without mentioning the Damp, which will ruin them in very few Years.

Thus we see, we cannot do without Masonry in this Construction; let us then examine if the Method given in the Note at Page 149 of the * Marshal's Memoirs, be preferable to the common one of facing and arming these Works: It is thus. "These Forts are practicable only in Places where Wood is plenty; but they may be constructed without Wood on the same System, observing always that the Counter-guards be made so that the Enemy cannot lodge there; a good brick Wall with a Scaffold behind seems sufficient for a Counter-guard.

This is also a new Method of constructing this Work: to judge properly of this Case, we should have a Design and full Description of these Scaffolds, which apparently must be kept in the Magazines, and not put up but when threatened with a Siege, otherwise

* Vide Page 140 of Essay on Fortification.

otherwise they will not last long, and the Expence of maintaining them will be very considerable; we should also shew how to preserve them from the artificial Fires which the Besiegers will not fail to use, in order to destroy them.

But, supposing all this meets with no Difficulty, there is another Reflection yet to make on this Construction. The Parapet of this Work, that is to cover the Troops, is composed only of this said brick Wall, elevated above 15 Feet from the Crown of the Glacis without any Earth: Experience has convinced us how fatal such Parapets are to the Defendants, and we may easily conceive how soon the Besiegers will ruin it with their Batteries in the Country; so that we must not expect the least Assistance from it, in the Defence of the Covert-way. The Enemy established on the Glacis, will tumble the Wall into the Ditch, and as the Ground of the Counter-guard is on a Level with the Horizon, it will be entirely covered from the Cannon of the Ravelins, too high to discover anything from their Terreplein, and nothing can prevent the Enemy from establishing their Batteries there, and ruining the Works, which they can see to the very Foot, and from which they are but a few Fathoms distant.

To avoid the Defects which undoubtedly arise from both the proposed Constructions, the best way will be to build them after the common Method, that is, to face and earth them, as we practise at present. We must in the mean time, shew how the Enemy will lodge themselves on the Counter-guard. Being established at the Foot of the Breach, as was said at the End of the preceding Chapter, they will make Ramps or Slopes to get on the Work, and will construct their Lodgment all along the Outerfacing or Revetement, defaced by the Cannon of the Covert-way, where they will neither be seen nor incommoded in any manner, and that because the Counter-guard is higher than the Ravelin and the Body of the Place. We may

may thus judge how easily they will establish themselves there, for they will have no more to do than to lodge between the Traverses at 3 or 4 Fathoms from the exterior Ditch, and they will find a Parapet ready made for their Lodgment. This will be particularly on the reentrant Angles, as they can make it there without the least molestation; as part of the Faces of the Ravelins, which is opposite to them, and should defend them, has only a simple Parapet without Terreplein, so that even Infantry cannot be placed there. Therefore only the middle of this Lodgment can be battered by the Cannon of the Ravelin, but as that fires à *Barbette*, or over the Parapet, those that serve them must be exposed, and some Platoons posted opposite to these Batteries, will effectually silence them, and absolutely oblige them to quit the Rampart, because it is commanded by the elevation of the Lodgment.

The Enemy will then ruin the Casemates under the salient Angles of the Counter-guard by Mines, and thus prevent the Retreat of the floating Batteries, which after that cannot be kept in the Ditch, exposed on all Sides to the Grenades, &c. of the Enemy; and if they do keep them there, it will be impossible to preserve them from being burnt.

The Batteries K on the Counter-guard being finished, the Besiegers will batter in Breach the reentrant Angles of the Ravelins L, and as the Extremities of their Faces, where they join and form the dry Ditch before the Bastion is no thicker than the Parapet, they will soon be beat down, and leave the flanked Angle and Faces of the Bastion exposed, which the Besiegers may afterwards ruin with the same Battery, and enclose the Flanks, so as to render them entirely useless to the Defence of the dry Ditch.

The Counter-guard being too high, and its Terreplein too narrow to make the Descent into the Ditch, the Besiegers must pierce it even with the Water, and we construct Galleries, to be able to make their Entrance

Entrance, into the Ditch, as well before the salient Angles, as before the reentrant Angles M, where they would make their Passage. As all these Places are absolutely covered from the Fire of the Place, because the Besieged cannot see the Front for the Height of the Ravelins, and as they cannot flank for the reentrant Angles of the Works, the Ditches will be filled, and the Bridges finished without molestation, in a very little Time. The Besiegers will then enlarge the Breach of the reentrant Angles, either by Cannon or Mines, and construct the Lodgment N on the salient Angle of the dry Ditch, which the Besieged can only oppose by the Fire of the Flanks; but as they are so small that they will not contain more than two or three Pieces of Cannon, and besides those of the Bastions attacked are enfiladed by the Batteries of the reentrant Angle of the Counter-guard, as we said before, it cannot be expected that they can prevent the Besiegers from perfecting the Lodgment, and maintaining themselves in it.

To render the Breach of the salient Angles of the Ravelins practicable, the Besiegers will be obliged to use Mines, as the Height and Proximity of the Counter-guard, prevent the Cannon, placed on its Templein, from plunging as much as they should.

The Lodgments at the Foot of the Ravelins being finished, the Besiegers will use Bombs, Stones, &c. to annoy the Troops posted in the dry Ditch, designed to support the Defendants of the Breach, in which the Lodgment of the Counter-guard will be of great assistance, since it surrounds and commands the Ravelin; and as that before the Point of the Bastion, marked N, also flanks them, and by its means, the Besieged can enter the Ditch, and charge them at the same time that they assault the salient Angles, it will be impossible for them to support themselves at the Foot of the Rampart, and in this Case the Retreat will be very dangerous, as it must be made by the Postern in the middle of the Curtain entirely exposed, and without

without any Protection, because of the Height of the
Body of the Place.

The Besieged being obliged to abandon the dry
Ditch, will find no Means of returning and destroying
the Works of the Besiegers, because the Passage by
the Postern becomes impracticable in Sight of the
Enemy, and as the Communication with the other
Bastions is cut off, by the Lodgments before the Bastions,
so well, that is it only by the Fire of the Curtains,
that they can oppose them in the Construction of the
Ravelin; we plainly see that this
will not be a sufficient Obstacle, and that nothing can
prevent the Besiegers from having a Communication
from the salient Angles to the Rentrants, and afterwards
constructing the Batteries O to ruin the Flanks,
and open the Faces of the Bastions, already damaged
by the Cannon of the Counter-guard.

As all the Lines of the Body of the Place, are of
small Extent, and entirely exposed to the Enemy
lodged in the Ravelin, they will quickly be disabled,
as the Bastions are so choaked, that the Bombs must
in very little Time dismount the Cannon, and drive
away the Troops which should defend the Breach,
effectually, that the Garrison attacked in this
last Refuge, will be obliged to capitulate; for the
Ravelier, though it surrounds the Place, cannot serve
as an Intrenchment, and is only raised to such an
elevative Height, that the Besieged may see into the
Country, and discover what passes in the Enemy's
Lodgments, in order to guard against their Attacks,
about which the Enemy would be hid from them,
soon as they should be obliged to abandon the
Counter-guard.

CHAPTER THE FOURTH.

A Comparison of the Advantages and Defects arising from this System.

WHAT has been already said of the Attack and Defence of this new System, has certainly proved, that if on one hand it remedies the Defects of modern Fortification, it is not exempted the other, from many Defects which arise from the said Corrections, and which often render them useless. Yet to know which Side has the Advantage, we collect under one View the different Effects arising from it, and compare them together, and we then venture some Reflections on the Change made by this System, to render the Works capable of greater Resistance.

All Engineers have hitherto agreed that we cannot do without small Arms in the Covert-way, and this for two Reasons; the first, because its Construction exposes it to Assault, as soon as the Enemy are arrived to the Foot of the Glacis, and the Besieged cannot oppose them but by Detachments, which should be at hand, and so disposed, as to support those that defend the salient Angles; without this, the Enemy might easily lodge there, before Succours sent from other Works could arrive, since most commonly they only communicate by Bridges or Boats, which requires much Time. The second Reason is, that the Retreat of the Sallies cannot be secured, but by a Fantry in the Covert-way, without which the Enemy might rush in with the Troops that came to oppose them, and make themselves Masters of it before they could be stopped. Surprises are not less to be feared, and might easily contribute to the Loss of the Work.

According to this reasoning, the Covert-way of modern Fortification, is only appropriated for Infan-

ry; but Experience has convinced us that Cannon
of very great Service to the Enemy in their
Trenches, and ruin their Batteries, and we have ne-
ver failed using them there with Success, tho' in a
manner so imperfect, that they could only be served
in the Night, as has been already said.

Marshal Saxe, considering the Advantage that Can-
non might be of in the Covert-way, without reflecting
on the Service that Infantry alone can produce in the
above Case, says, "that the Custom of crowding the
Covert-way with Troops, and keeping a great Fire
of small Arms from thence, signifies nothing, since
it only fatigues the Troops, in proportion as it is
increased, and that the Fire on the Workmen in
the Night, is but a notion, that Batteries of Can-
non à *Barbette* are much better, as the Fire will be
much more effectual than that of small Arms, as it
pierces Gabions and Fascines, and the Bullets,
sweeping the whole Breadth of the Trenches, will
fly by Bounds and Ricochets much farther than
their first Range; in fine, he says, that 12 Pièces
of Cannon, thus disposed, will do more Mischief
than a thousand Men, who shall have passed the
Night in this Work.

Agreeable to this Idea, the Covert-way in this new
System is accommodated for the Use of Cannon only,
without the means of placing Infantry there, as we
demonstrated in Chap. 2. where, at the same time,
we shewed, that on that account it is exposed to sur-
prises, subject to be insulted, and not at all proper for
Batteries, besides which, by the Nature of the Batteries,
the Effect of the Cannon must be very uncertain; to
which we must also add, that the Scaffold Platforms
are so elevated that the Traverses do not exceed them
but by about two Feet, or thereabouts, which is not
sufficient to guard against the Ricochet, and being
lined by the Bombs, which the Enemy will not fail
to throw on this occasion, the Enemy will have much
difficulty to remount them, being so excluded, that
they cannot come there but by the Ditch, which is very

difficult in such a Situation, where the Level of the Water is 12 Feet lower than the Covert-way, and entirely impossible when this Height is greater, especially for transporting Cannon and Materials, unless we change the Construction into a Slope, which on the other Hand, will not be without Inconvenience, as one may judge.

From these Considerations it naturally results, that to render the Covert-way most effectual for the Defence, it must be so constructed, that Cannon may be used there without difficulty as well as small Arms ; and as it is proved by Experience that every Work is imperfect, where both these kinds of Arms cannot be used, and cannot effectually defend itself, there is no reason to exclude the Covert-way from this rule ; as we cannot on the one hand expect any Advantage from its Glacis for the Use of Cannon, (the only Obstacle) so on the other, a simple Parapet, with a Ditch next the Country, cannot procure many that we obtain by that Construction, such as a Security against Surprises, the means of making Sallies with Success, and of supporting those little Works, which are advanced into the Country, to stop the Enemy's Approaches.

As the Traverses in the Marshal's System do not decrease their Defects, but on the contrary cause greater Embarrassment, in Proportion as they are more numerous, it seems better to reject them entirely, as many Engineers of Reputation have already practised and rather expose the Troops to the Ricochet, than afford means to the Enemy of lodging and supporting themselves in the Covert-way : To this we must add, that in the Construction with a Parapet, which we mentioned, the Ricochet is less to be feared than in that with a Glacis. As we are not exposed to sudden Attacks, and the Defence of the Country not depending on small Arms only, the Troops need not line the Covert-way continually, but keep in the Intrenchments of the reentrant Angles, while the Cannon

* Vide Page 25, Essay on Fortification.

the saliant Angles, charged with Cartridge, shall fire on the Trench, and defend the Side of the advanced Ditch, if any.

The Idea of covering the Body of the Place, so as absolutely not to be seen from the Country is entirely new. Hitherto we have only endeavoured to keep the Enemy from seeing the Foot of the Wall of the Body of the Place, by advanced Works, and by their Elevation prevent them from discovering the Defences, so much as may enable them to ruin them. On which the Marshal observes, that though the Besiegers cannot ruin the Defences, they will hinder the Besieged from using them, and on the other hand, the Elevation of the Body of the Place does not procure them a means of firing on the Glacis, while there are so many Troops in the advanced Works, and that it is also useless that the Body of the Place be seen over the Works from the Glacis, as it can only serve to defend those which are directly before it.

From which he concludes, "that he would rather that the Defences next the Body of the Place were lowest, because the Enemy will be obliged to transport Cannon from one Work to another to ruin them, which will not be very easy, especially if the Works be so constructed, that there be no Earth in some, and much in others, and that they can be reattacked, before the Enemy can perfect their Lodgement.

How specious soever this new Theory appears, it meets with many Difficulties in the Execution, as we have shewn in the preceding Chapter, and which we shall here more particularly prove. The principal Design of this System is, that the Body of the Place and the Ravelins be exposed to the Enemy's Sight alternately, and that one Work should not be destroyed by the Batteries erected in that directly before it: the Defect arising from this Disposition is, that every Work can only be defended by itself, and the others in no ways contribute towards it, which is a great defect, especially in this System, and for this Reason.

The different Enclosures formed by the Counter-guard and Ravelins, and designed to cover the Body of the Place, only compose Tenailles, a kind of Work imperfect in all kinds of Fortification, because all the Defences are seen in Front, and may be ruined by one Battery only, erected in the middle of the Line. This Defect increases, in Proportion as the Angle of the Tenaille is more open, so much, that in the given Plan, where the Branches of the Counter-guard form an Angle of 140 Degrees, it is impossible that they can flank one another, and they depend on the Defence of the Front, which on Account of the Height of the Work, cannot prevent the Passage of the Ditch, as has been shewn in the preceding Chapter.

This seems to prove that it is better to oppose the Enemy many Works at once, capable of supporting each other reciprocally, as those which are discovered one after another, are reduced each to its own proper Defence; above all, when we take care to cover the Body of the Place in the most material Places such as the Faces, to hide the Foot of the Wall, and to diminish the Height of those Parts most exposed to the Enemy's Fire.

In the Counter-guard the Marshal has endeavoured to deprive the Enemy of any means of lodging themselves on the Terreplein, but he has not made it broad enough to use Cannon there; this Work therefore cannot much oppose the Enemy, when they would post themselves on the Glacis, and as it is very high, the Parapets will be broke down by the Batteries of the Country, and consequently rendered useless for the Defence of the Covert-way.

Counter-guards are now seldom used, on account of the many Inconveniences arising from them; and whatever Care the Marshal has taken to remedy them in his Construction, they still subsist, and the Height he gives them increases their Defects, and renders the Work much more hurtful, than advantagious to the Defence, as I believe we have proved above.

The manner of tracing the Ditches is particular in this System, and founded on the Custom of making Work very nearly parallel to the Faces; which furnishes the all the Enemy with much ground for his Batteries on the said by or Angles, and consequently affords them an opportunity of ruining the opposite Flanks. We cannot say that this Defect does not appear in the common given method, chiefly when the Enemy can erect their batteries on the Crown of the Glacis, for it is not so when they are obliged to construct them on the Ter-Defence of the Covert-way, where they do not find near much Room. But it does not appear that the Ad-ditch, vantage this Construction procures can counterballance the Defect that accompanies it, particularly in this System, where the Besiegers need only raise their Batteries on the salient Angles to ruin the Defences of the counter-guard and Ravelins, as they present their own Front, as we have said above, and where, on the other Hand, the Ditches already badly defended, so narrow in the Place where they make their Passage, that they are not half so broad as they are usually made, so that their filling, commonly so troublesome and tedious, will here be done in a very little time, and without the least Difficulty.

Though this Scheme of depriving the Enemy of Ground on the salient Angles cannot be of any use this System, but on the contrary become hurtful, may nevertheless use it with Success in the common method, where the Batteries on the Covert-way can easily discover the Flanks; but instead of diminishing the Breadth of the Ditch, as here practised, which is very prejudicial to the Defence, there must be placed Works before the flanked Angle of the Basin; so that they may hide the Flanks from the Enemy, without hindering the said Flanks from seeing the Passage of the Ditch from end to end, and opposing it rende with all their Cannon.

The Ravelins, whose Faces are prolonged so as to meet at some Distance opposite the Points of the Basin, form a Tenaille, like the Counter-guard, and altho'

altho' the flanking or reentrant Angle is less open, they cannot reciprocally defend each other, any more than the Counter-guard; because for the Distance of more than 12 Fathoms, from the right and left of this Angle, they have only a simple Parapet without Terrain, seemingly to disengage them from the Face of the Bastions, which without this, would in a manner be enclosed in the Rampart of the Ravelins; this is the Reason that the Ditch before the Salients is not at all defended; but if a Remedy was found for this Defect, it must be observed, that the Reentrant Angles are subject still to a much greater Defect, which is inseparable, and which increases in Proportion to the Height of the Works; for here where the Elevation of the Ravelins is 30 Feet from the Level of the Water, the Cannon placed à *Barbette* over their Parapets cannot discover the Ditch, but at 30 Fathoms distance from the said Angle, so that the Enemy can pass all that Space without being perceived, which is contrary to the Rules of the Art, and gives an Opportunity of forming a third Attack, on the reentrant Angle, which is so prejudicial to the Defence, that it cuts off the Communication, and takes the Defendants in the Breach in Rear, as has been shewn in the preceding Chapter.

No one can deny that the Marshal was well acquainted with the Cause that Outworks are capable of so little Resistance, he is astonished, that notwithstanding this Defect, we always make them detached Works, and thus deprive them of all Communication. The proposed Alteration certainly remedies that Defect; but it is to be feared that the Scheme of making the Ravelins one continued Enclosure does not answer the end proposed; because the interior is too spacious, and furnishes the Enemy with too much Ground to establish themselves there; to which must also be added, that the Postern to communicate with these Works, not being covered by any Work, which at the same time might protect the Sallies, the Retreat must infallibly be made in Disorder, and it is afterwards impossi-

en, the possible that the Troops once drove in, can return ; more than supposing with the Marshal, that in case they were impelled, they need only retreat to the Foot of the Body of the Place, where they will be supported without being forced to quit the dry Ditch ; this does not seem very probable, especially when we consider that they may be attacked in Front and Flank.

From what has been said, we may conclude, that the Ravelins would better answer their Design, if they formed detached Works, so as to flank one another, and communicated by means of Ramparts less elevated, which at the same Time might procure them a new Defence. It is true, this Disposition would not entirely cover the Body of the Place ; but besides, having proved that the Defects of such a System surpass the Advantages, we have also shewn in the preceding chapter, that Ravelins, though they form a continued enclosure, do not cover it better, and that the Enemy may ruin the Defences of the Bastions, without their contributing in the least to the Defence.

What we have proposed in the Change of the Ravelins will still be better, if the Bastions are at the usual distance from each other ; that would permit these Works to be placed as well before the Flanks as before the Curtains, where we might at the same time construct a Tenaille, to cover the Gate of Communication ; by this we should obtain the Advantages of covering the flanked Angles of the Bastions, and of keeping off the Enemy ; of defending the Ditch with Cannon and small Arms from many Places at once ; of seeing the Breach of the Outworks in Rear ; of securing Retreat to Sallies ; and of returning to the Charge often as should be found necessary.

The Polygon of this System being not half as large as usual, all the Lines of the Body of the Place are out of Proportion, and the Bastions so confined that they promise no great Service. This Defect is also in Consequence of covering the Body of the Place ; for if the Polygon was of the usual Size, the Faces of the Ravelins would become as long again, and their Contents

four times greater, which would furnish the Enemy with immense Room, and require an excessive Number of Troops for their Defence.

The Cavalier is an Invention as new as the other Parts of this Fortification : Without contributing in the least to the Defence, it is only constructed for the Casemates to lodge the Garrison in, and to secure them from the Enemy's Fire, in Case of a Siege ; without which, it would be impossible to remain in such a Place, that is not 100 Fathoms Diameter ; but it must be observed, that it would not be necessary to elevate it to such a Height, if it was not for the Reason alledged at the end of the preceding Chapter, and which spring from the same Cause, as many other Defects we have remarked in this System.

This is not the Place to examine if this Method of lodging the Troops would not be very hurtful to their Health, who must always live in Casemates under Ground, consequently damp, and badly aired, were they even built of Masonry. We cannot even doubt these bad Effects, if we reflect that the Cavalier, whose Height is one tenth Part of the interior Diameter of the Place, forms a kind of Funnel, where the Air can not be renewed, as often as it should, to prevent the Corruption that 3000 or 4000 Men lodged so close must infallibly produce, and which the Exhalations of Ditches full of Water must also increase.

Thus we have shewn our Reflections, which do not much agree with the Marshal's Sentiments. As the Novelty of the Subject may be the Cause of this Difference, we must resign ourselves to the Judgment of the Connoisseurs ; and our Labours will be recompensed if these Observations, such as they are, may create an Emulation in others, to reflect on a Subject, which so nearly concerns the Preservation of States, and the Security of the People.

F I N I S.



Fig. 1.

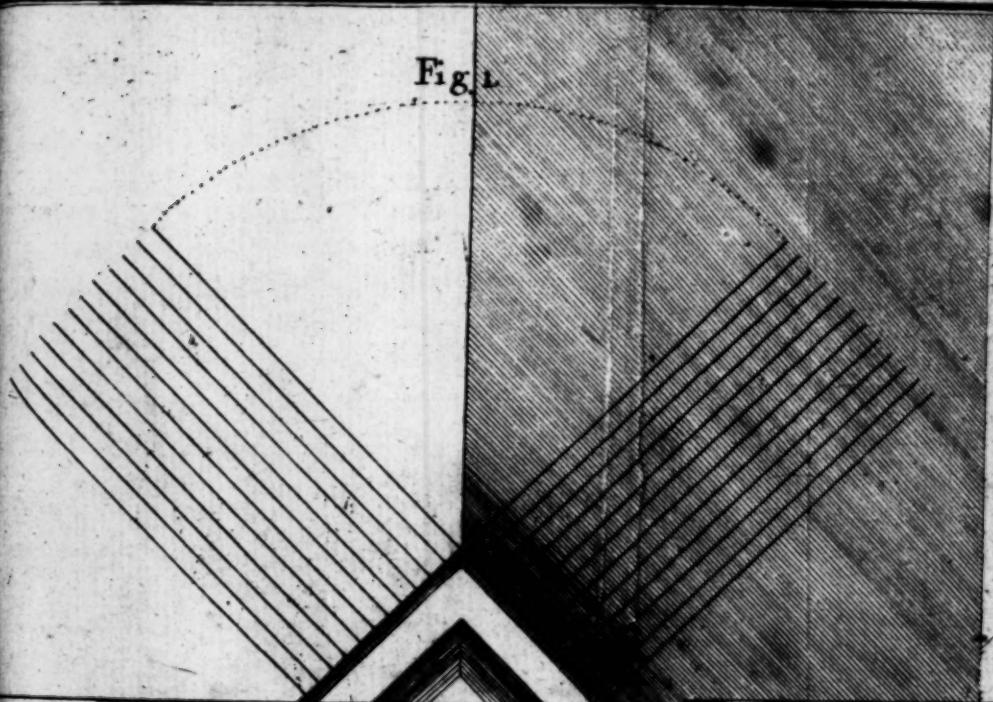
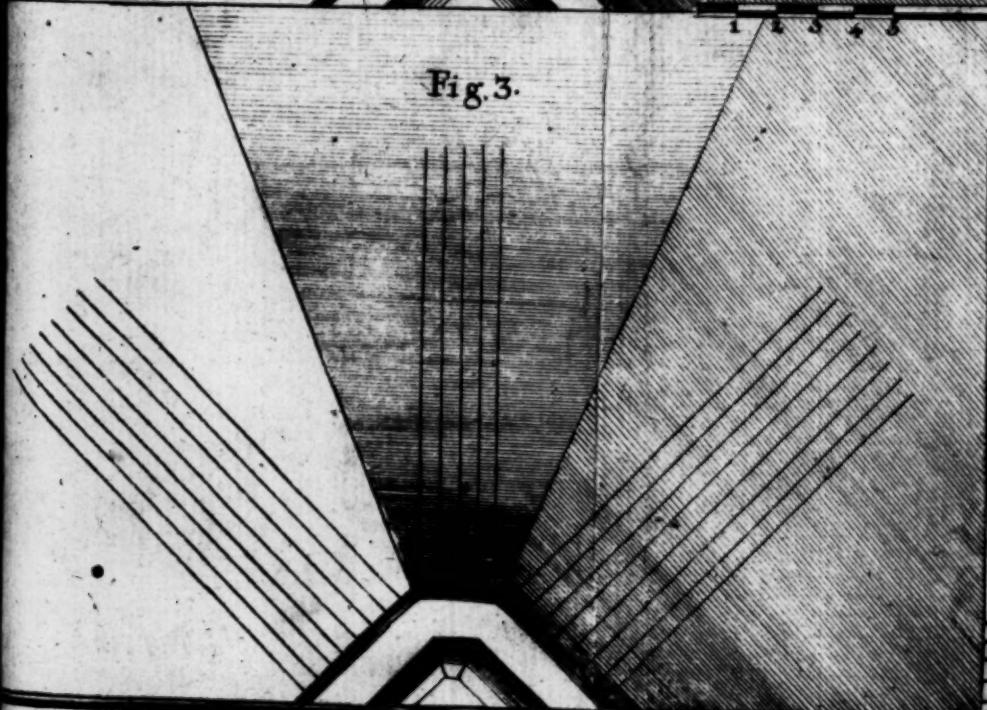


Fig. 3.



ANGLES

Plate 1. Page

Fig. 2.

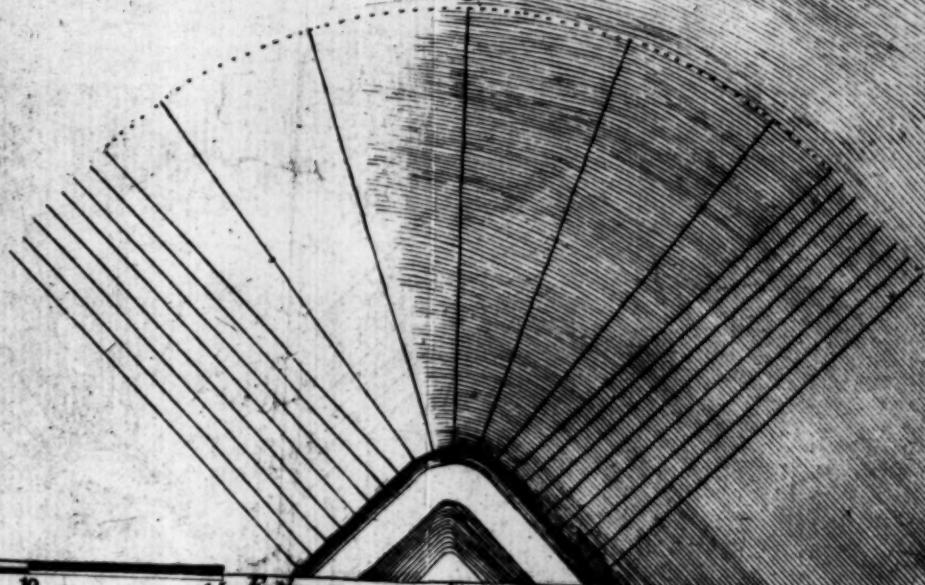
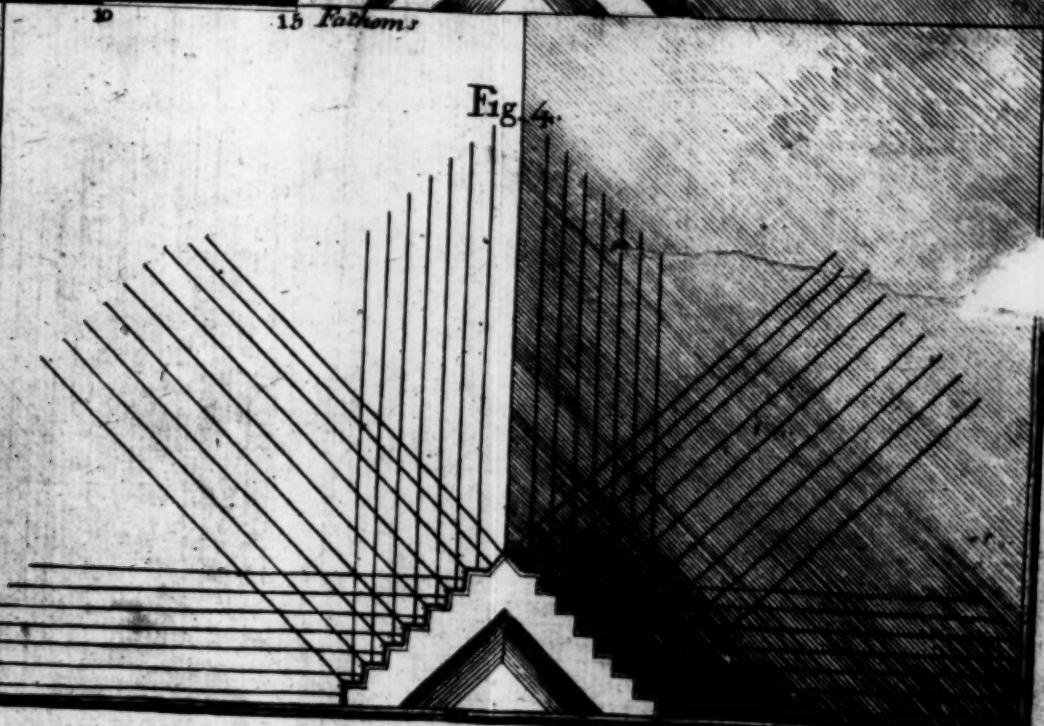
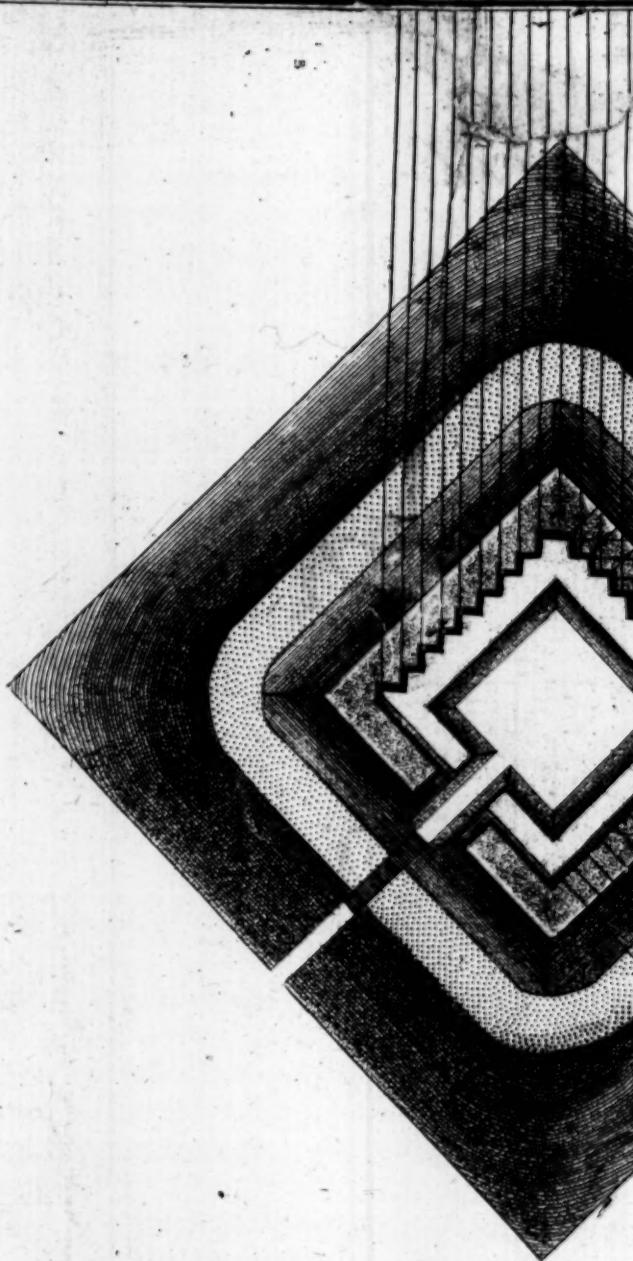


Fig. 4.



A REDOUT A CREE

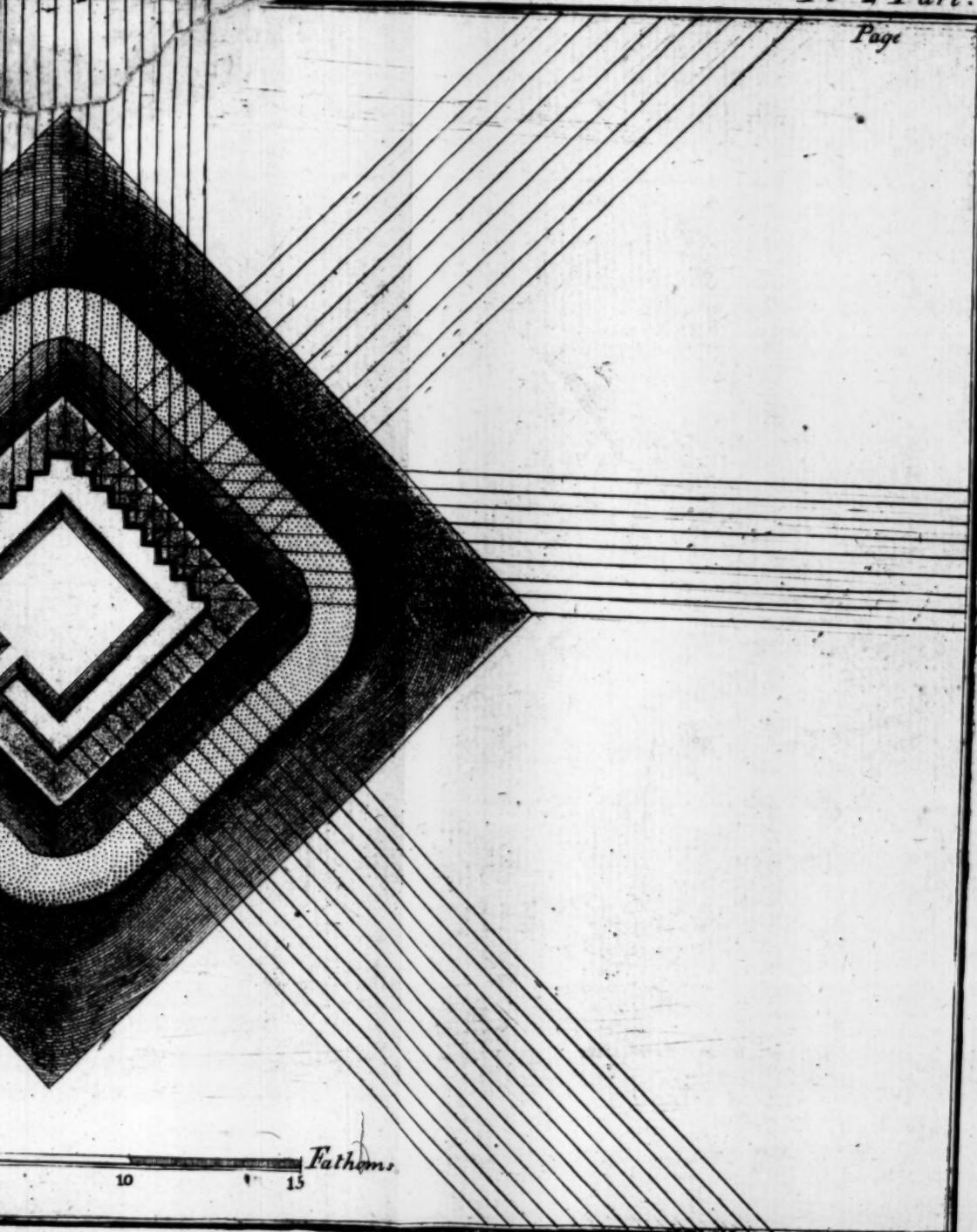


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A CREMAILLERE

Pl. 2 Part. 1

Page



10

15

Fathoms.

S T A R

F O



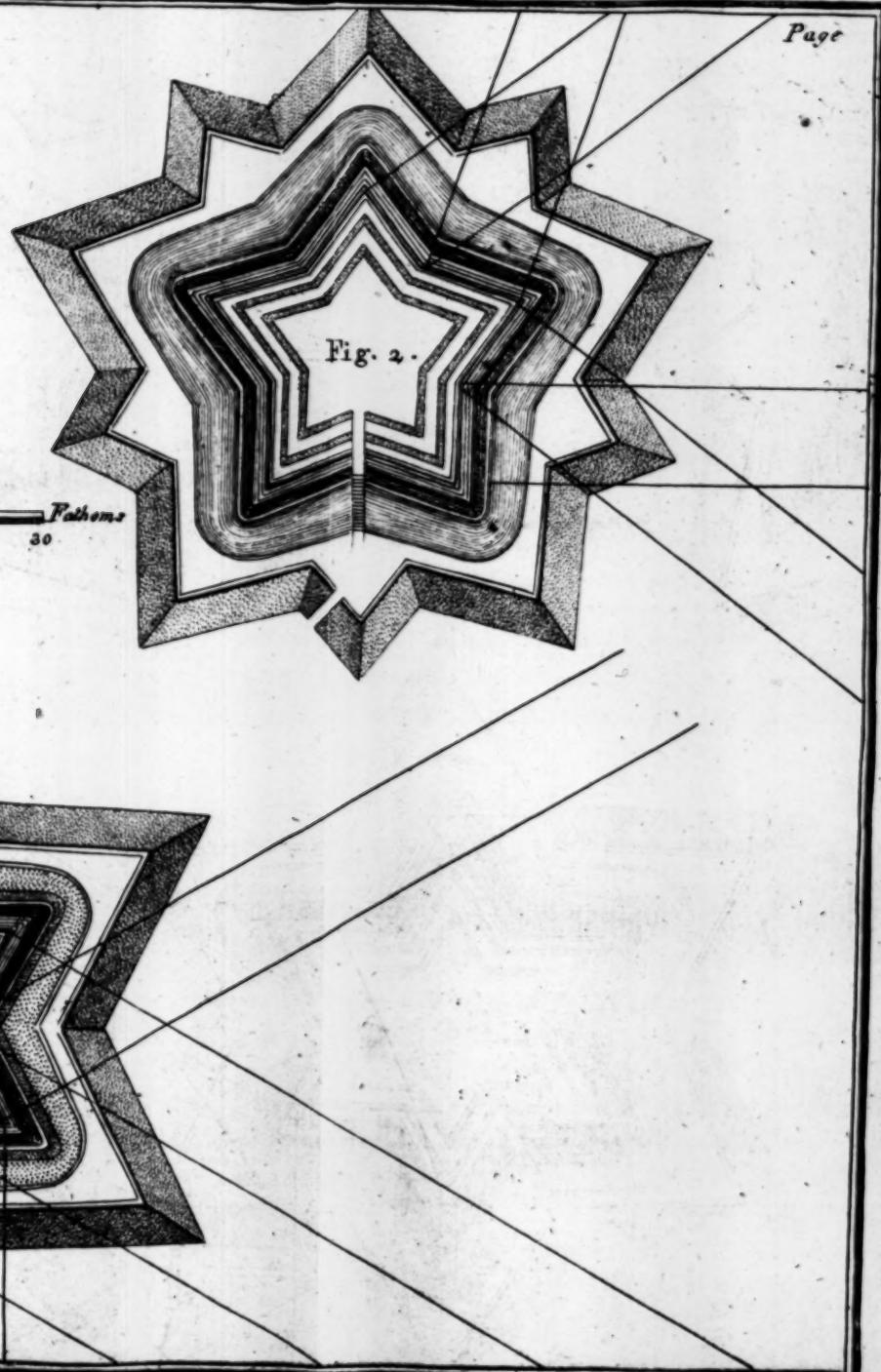
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FORTS

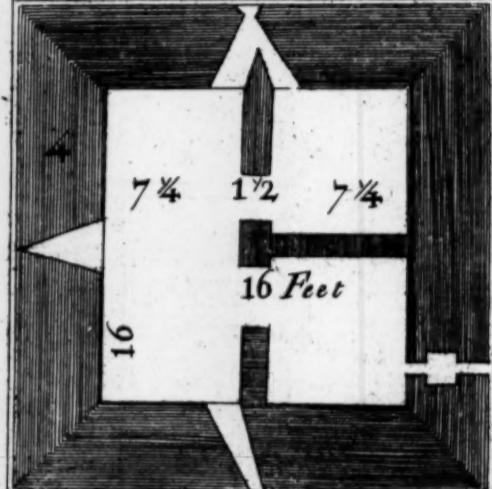
Plate 3.

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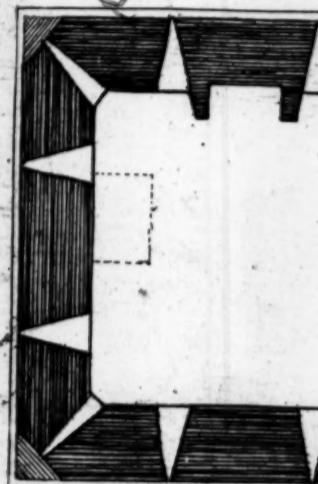


A REDOUT A MACHIC

1
Ground Plot or Magazine



2
Guard Room



3 6 5 30

Plan & Profile of a Redout

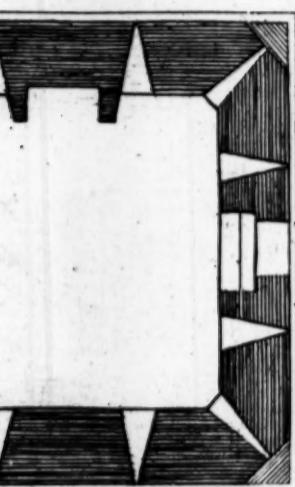
a Magazine



MACHICOULIS

Pl 2, Part 2.

2
Room



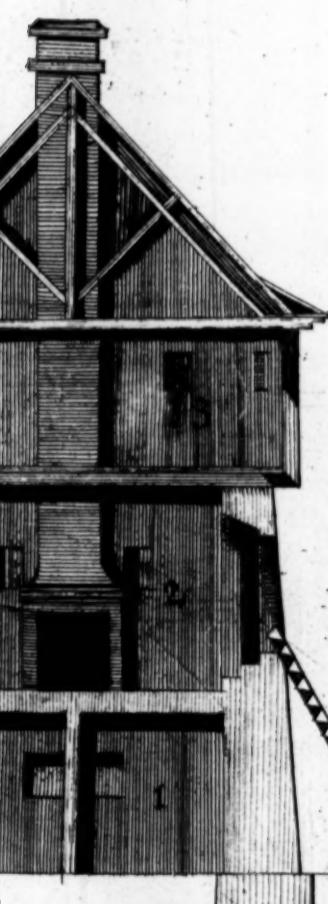
3

Machicoules Story



$\frac{10}{60}$ Fathoms or
Feet

at Machicoulis. at Dunkirk



STAR FORTS

Fig. 1

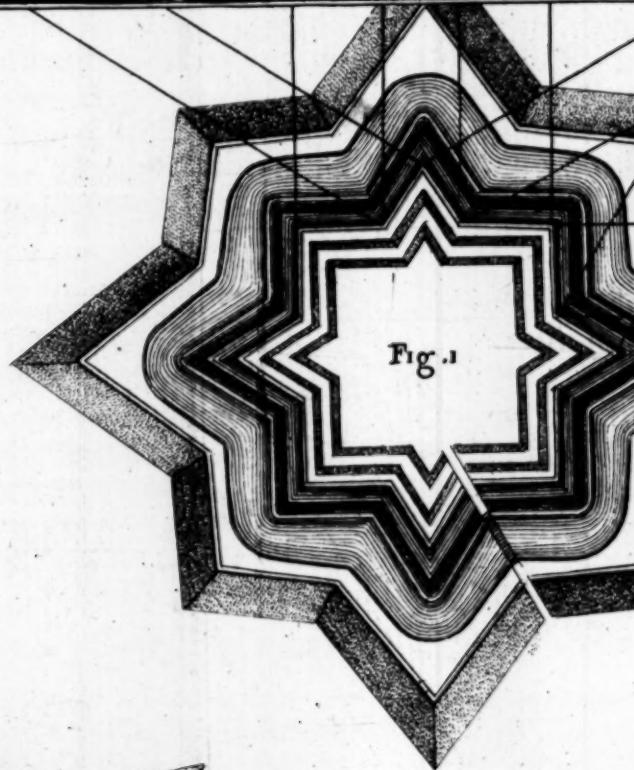
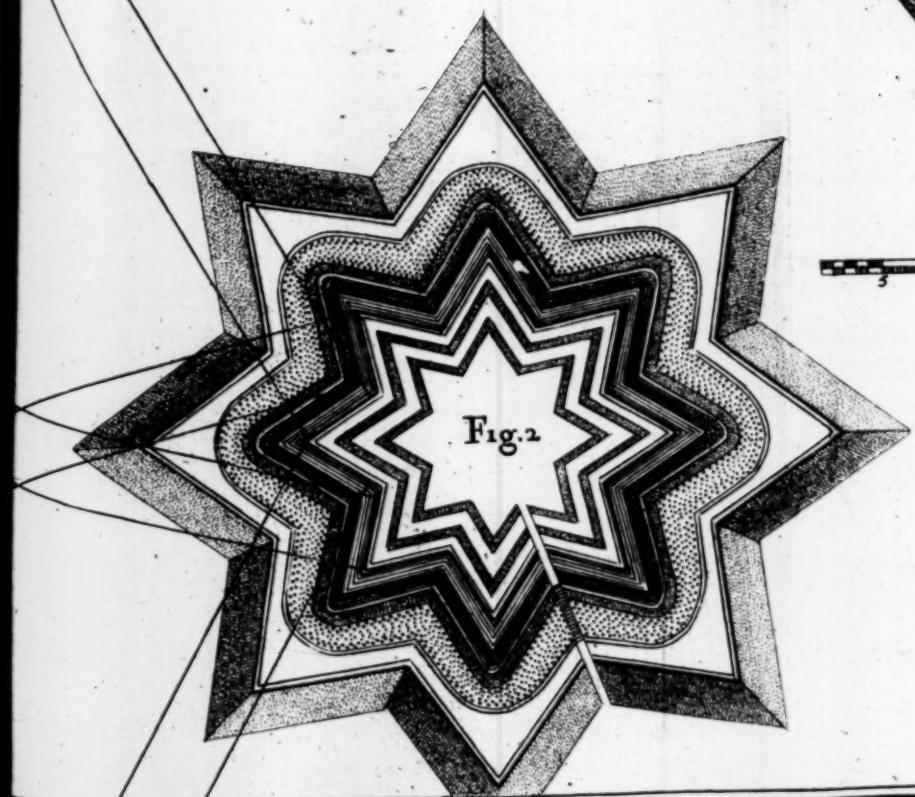


Fig. 2

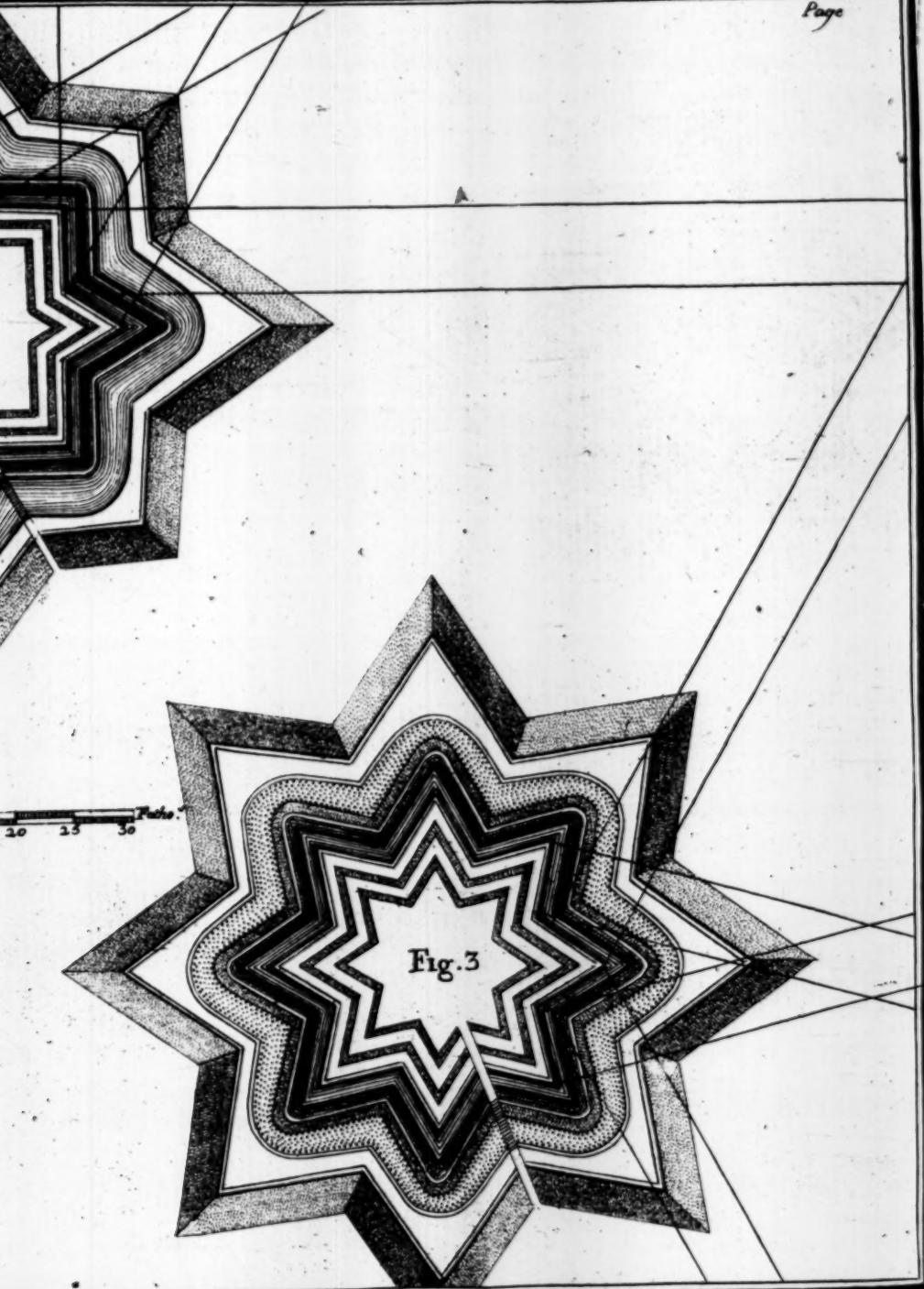


5 10 15 20 25 30

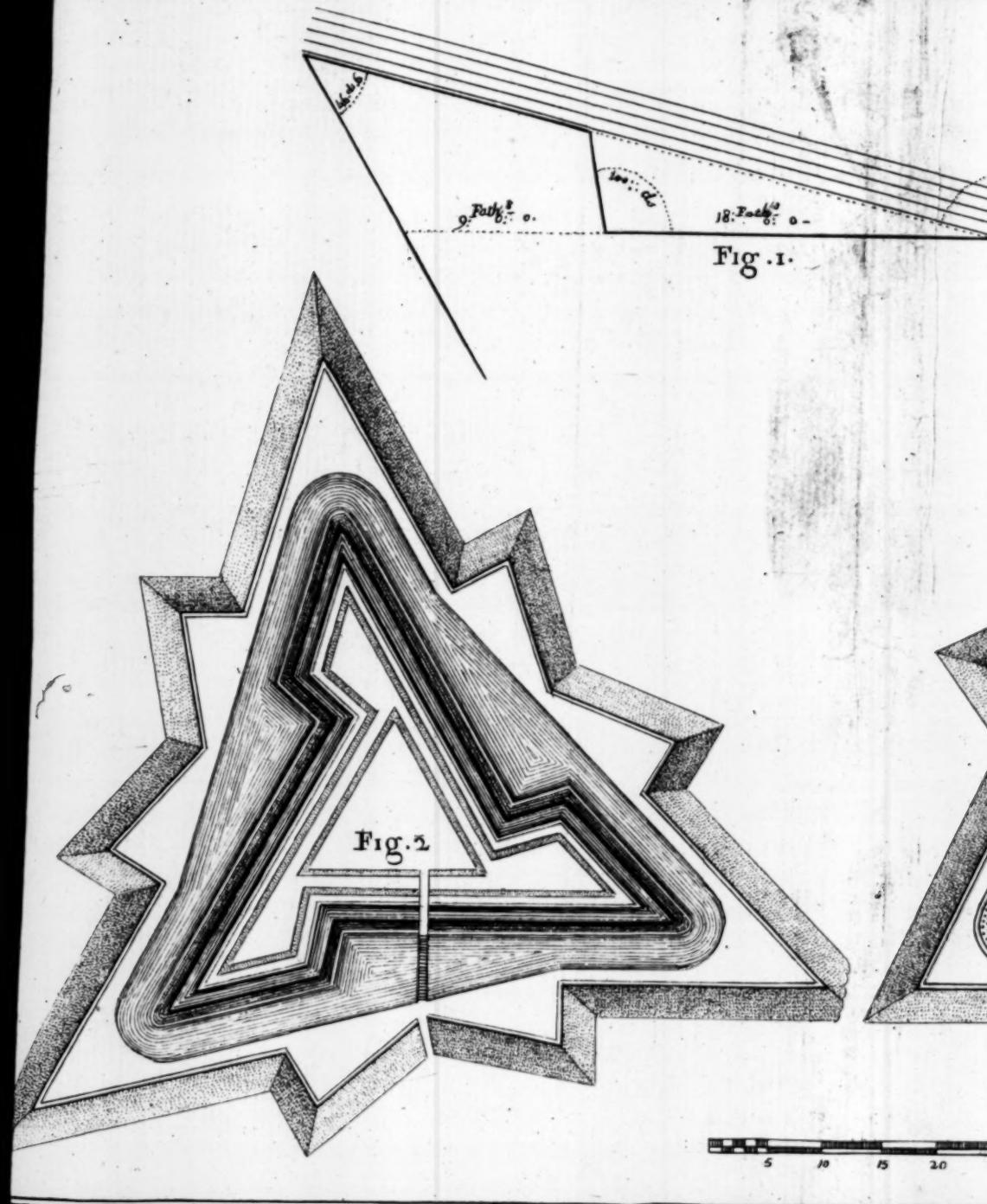
R T S

Plate 4

Page



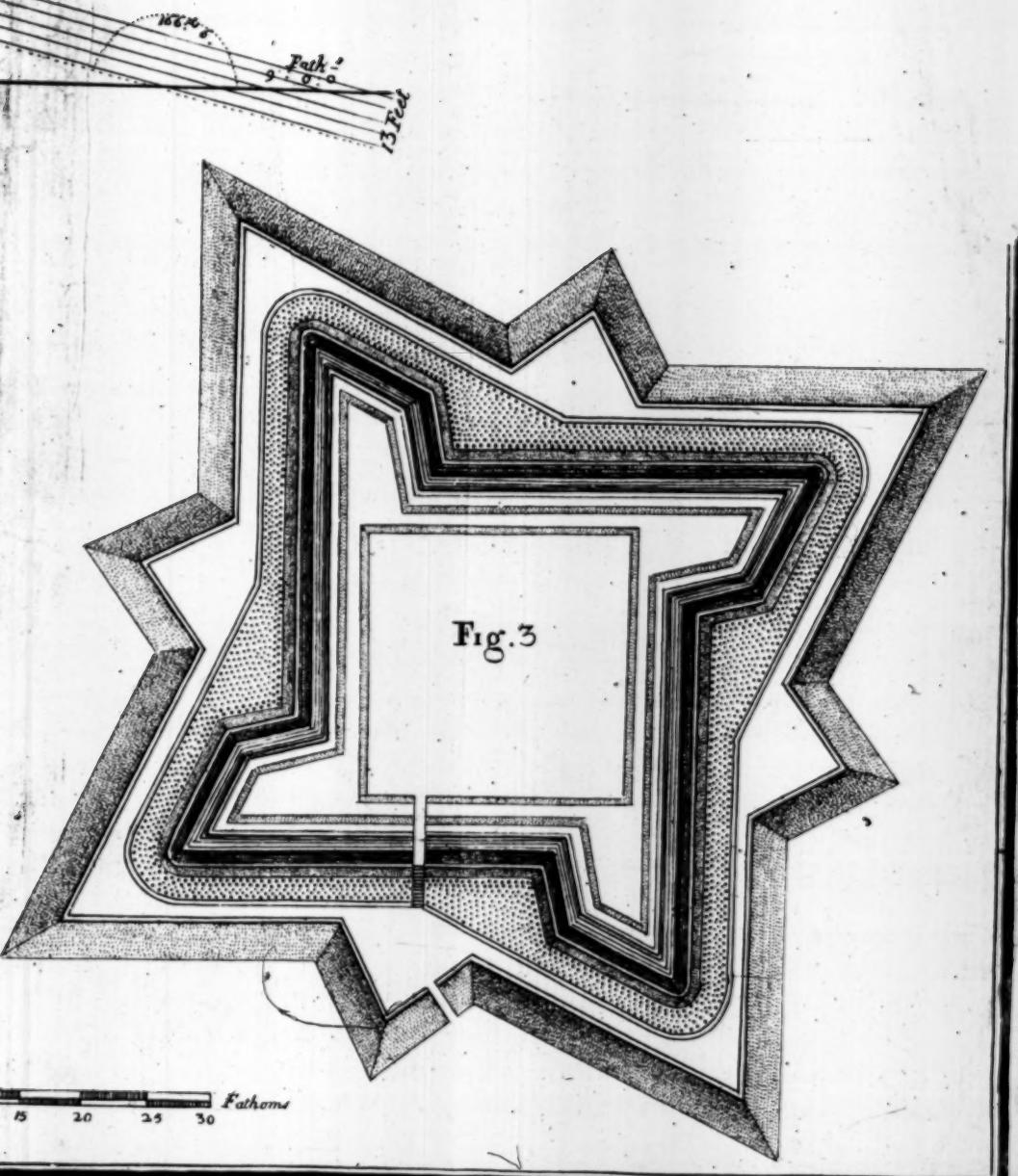
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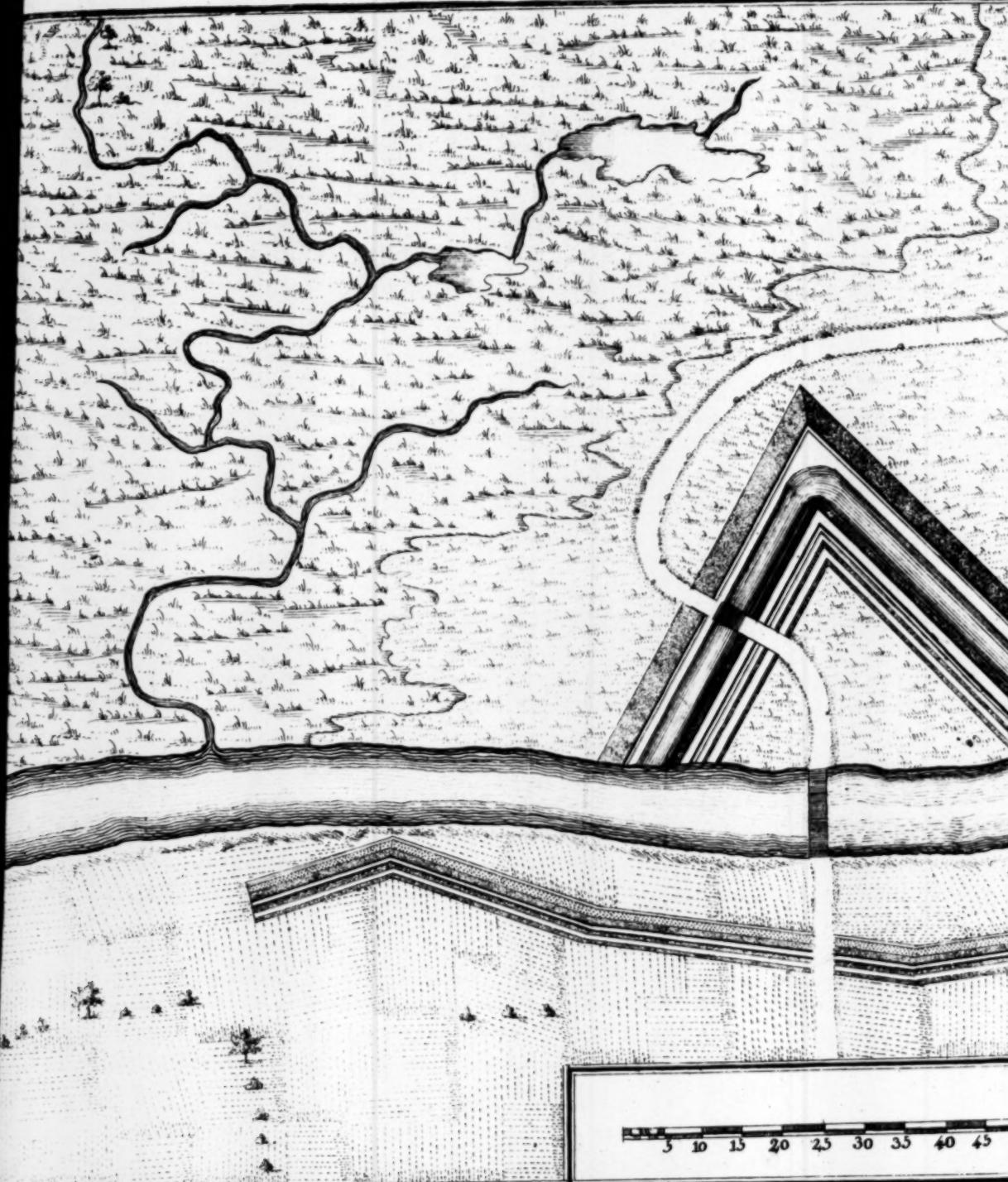
FORTS

Plate 5

Page



HEADS OF BRIDGE



D G E S

Plate. 6.

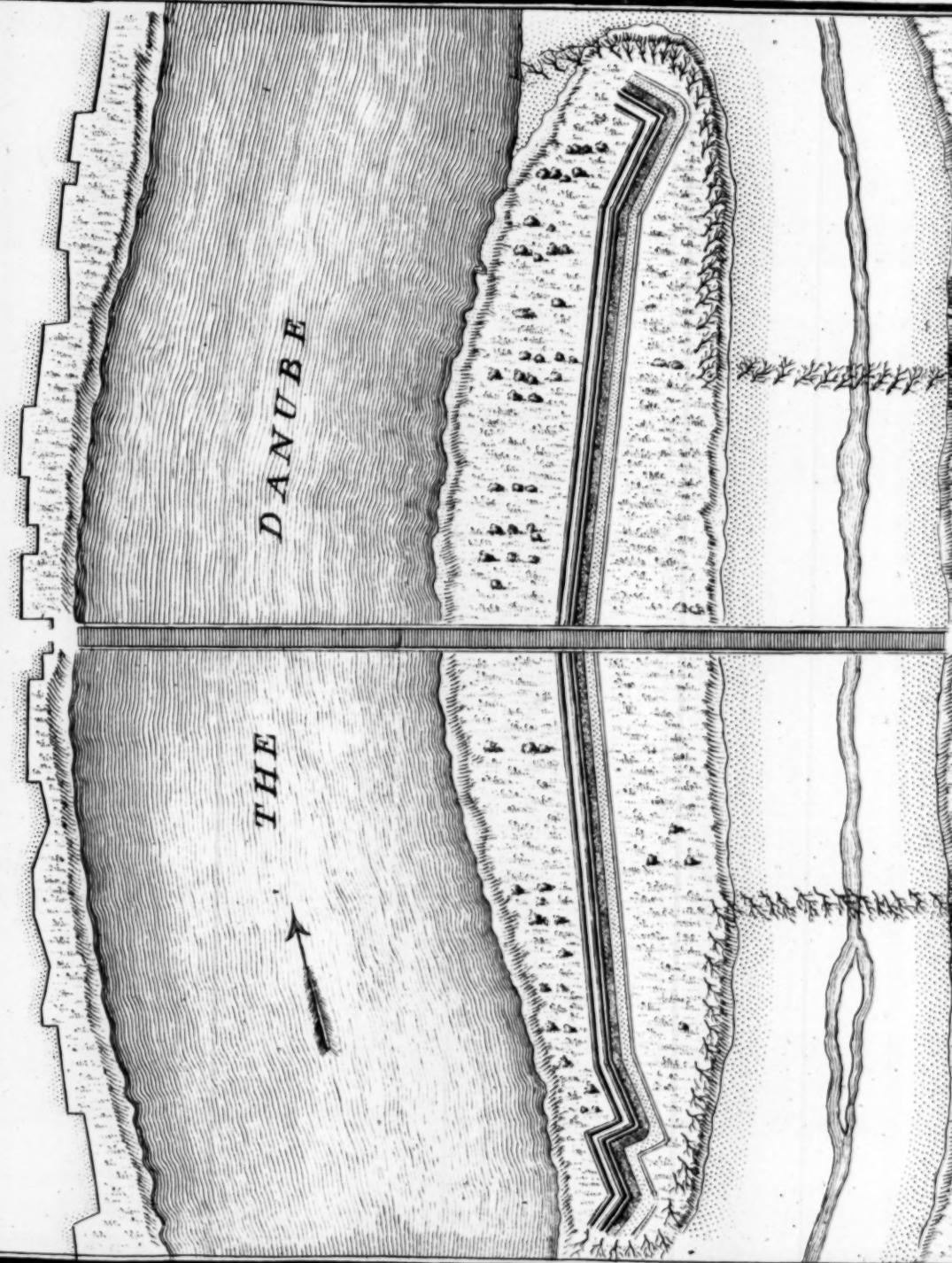
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HEADS OF BRIDGES

DONASTAUF

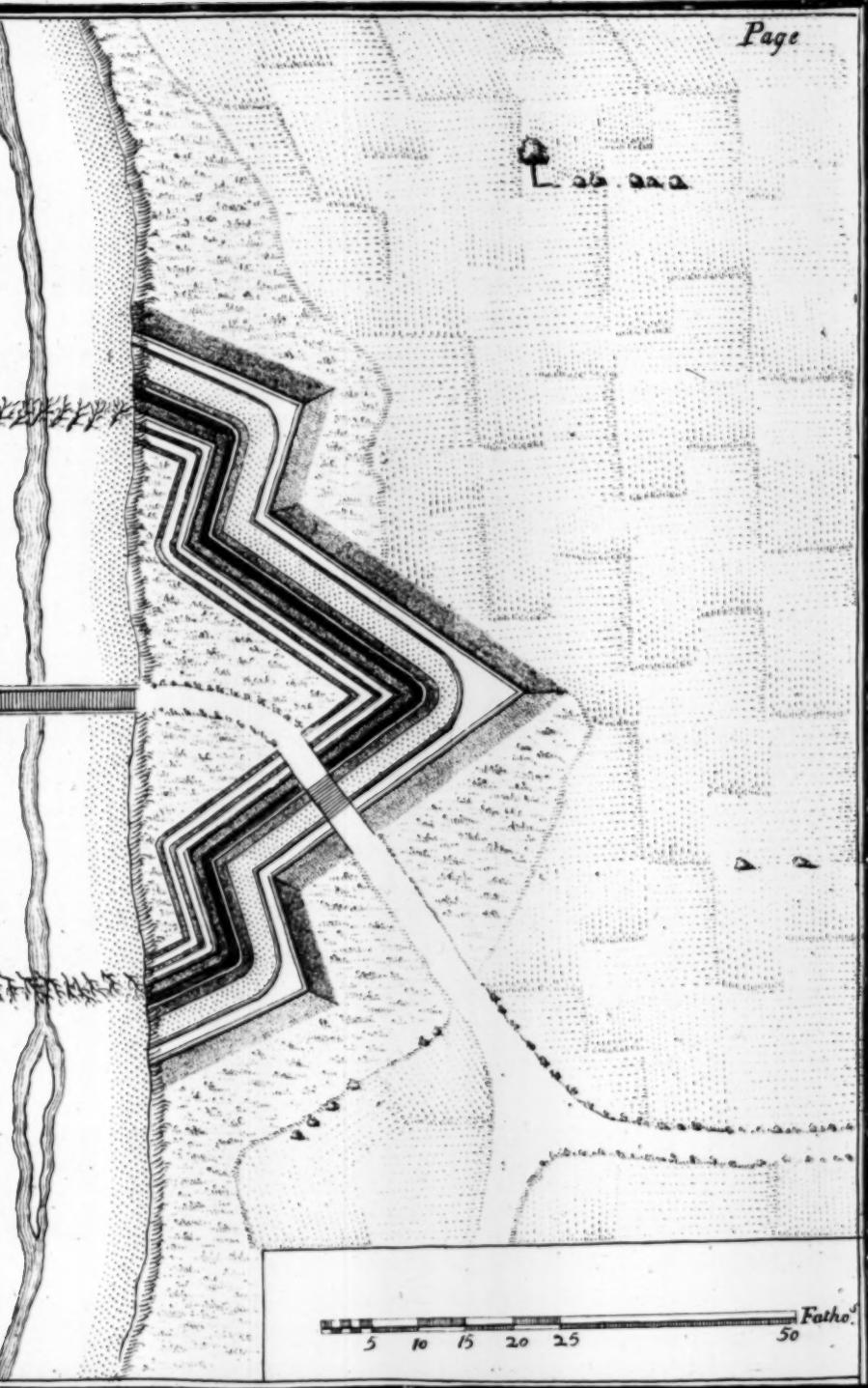
THE DANUBE



GES

Plate 7

Page



?

H E A D S O . F B R I

R H I N E

T H E



B R I D G E S

Plate 8

Page

Fig. 1.

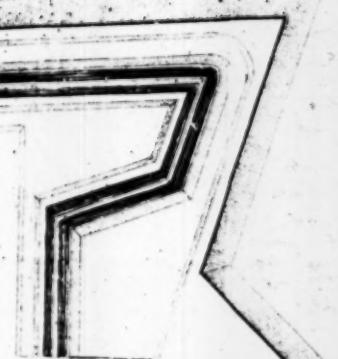
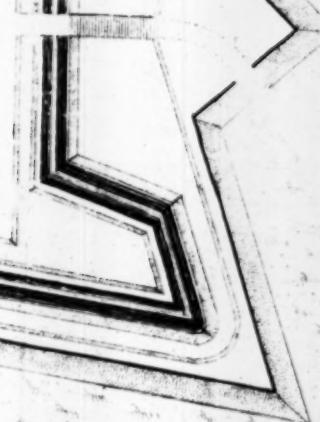
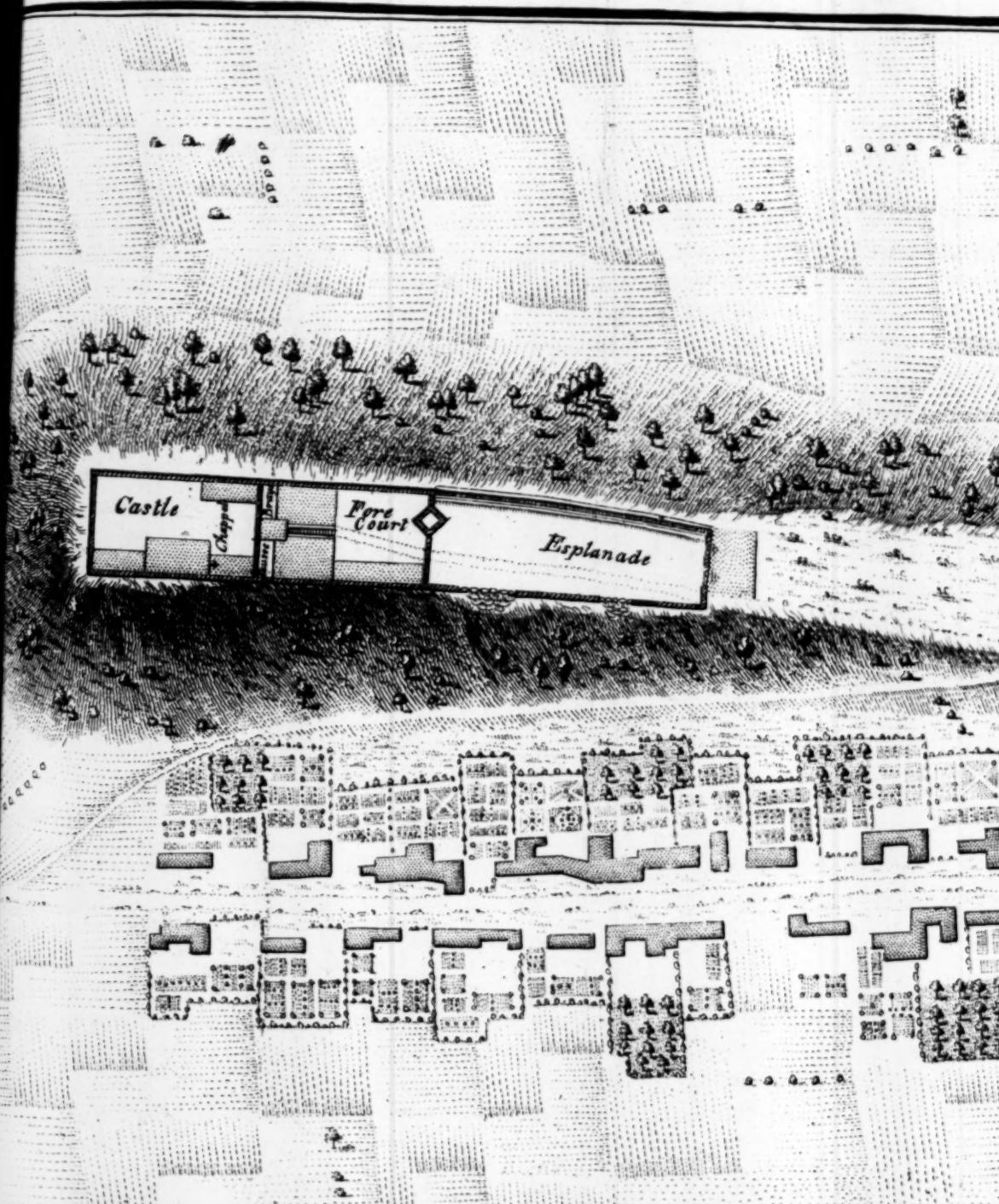


Fig. 2.



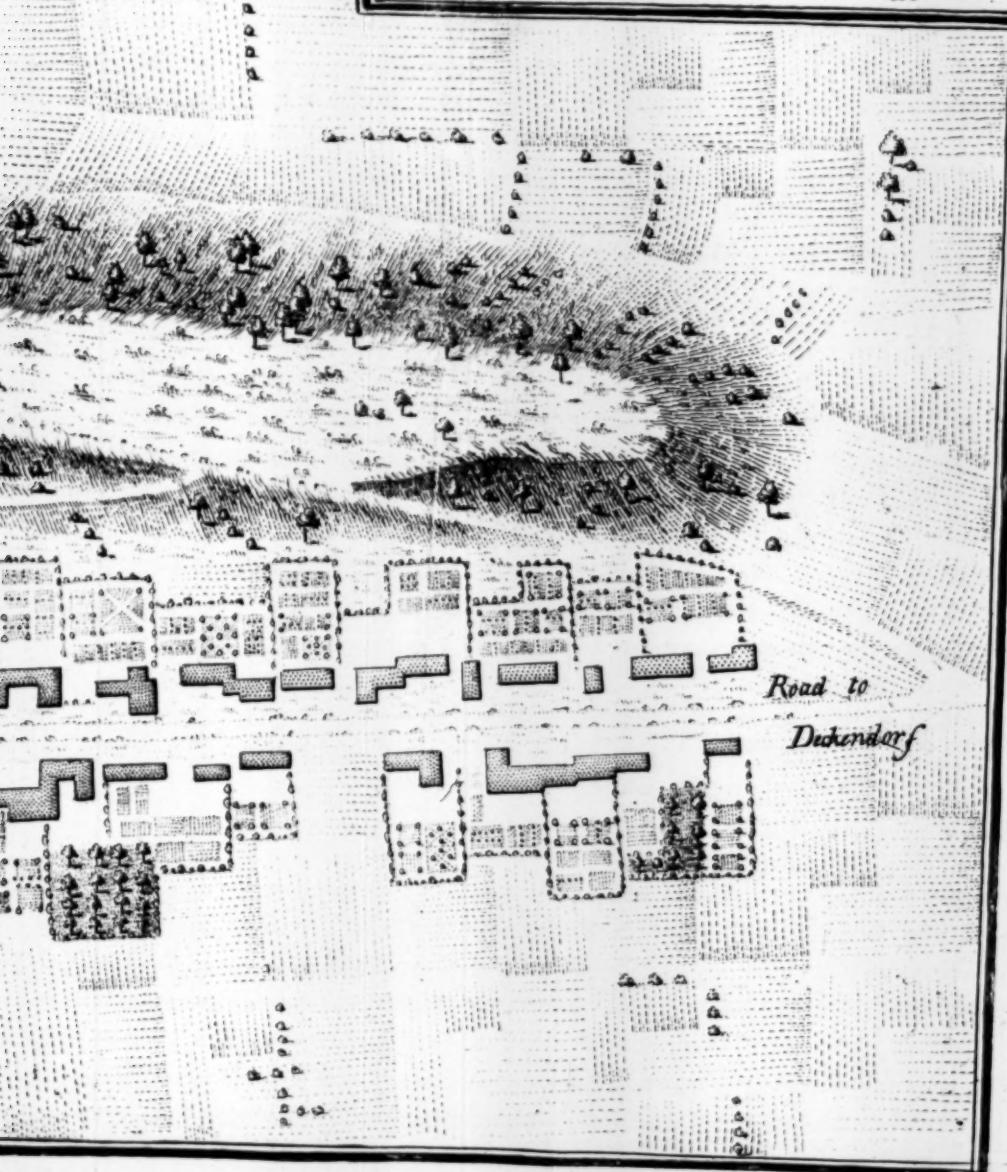
5 10 15 20 25 Fathoms
30

OLD CASTLES

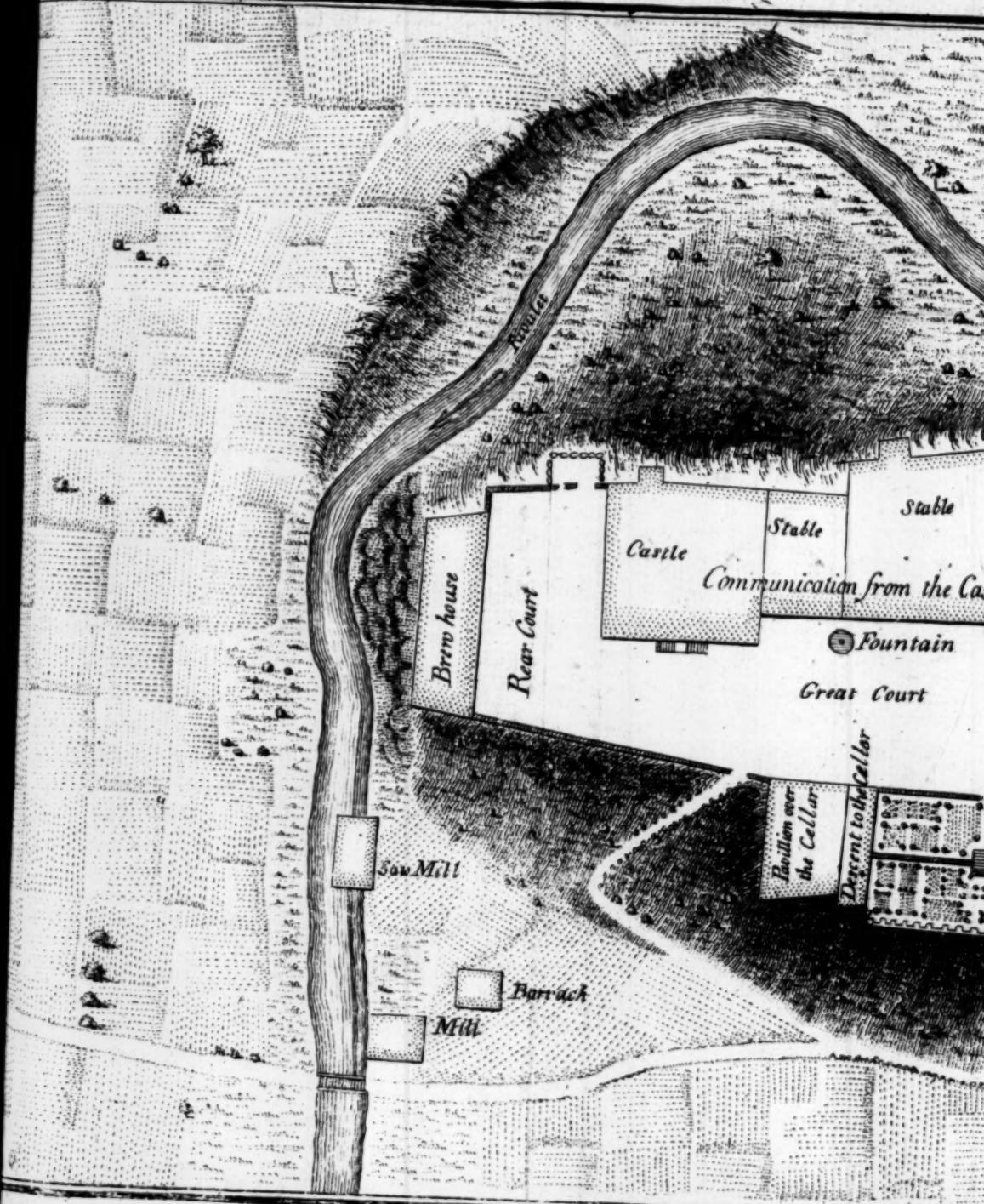


NATERBERG
Castle near Deckendorf

3 10 20 30 40 50 100 Fathoms



COUNTRY HOU

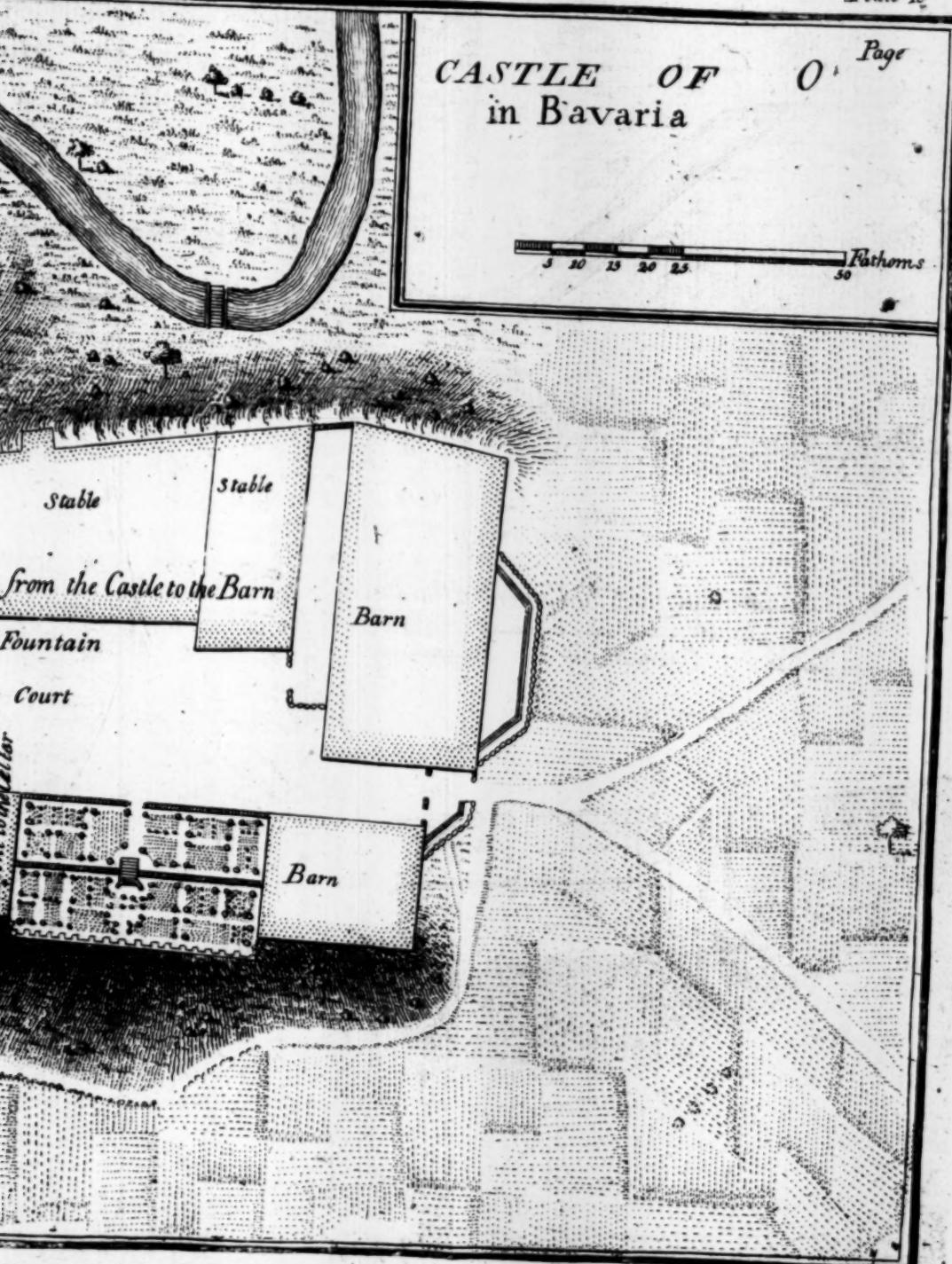


HOUSE

Plate 10

CASTLE OF O^{Page}
in Bavaria

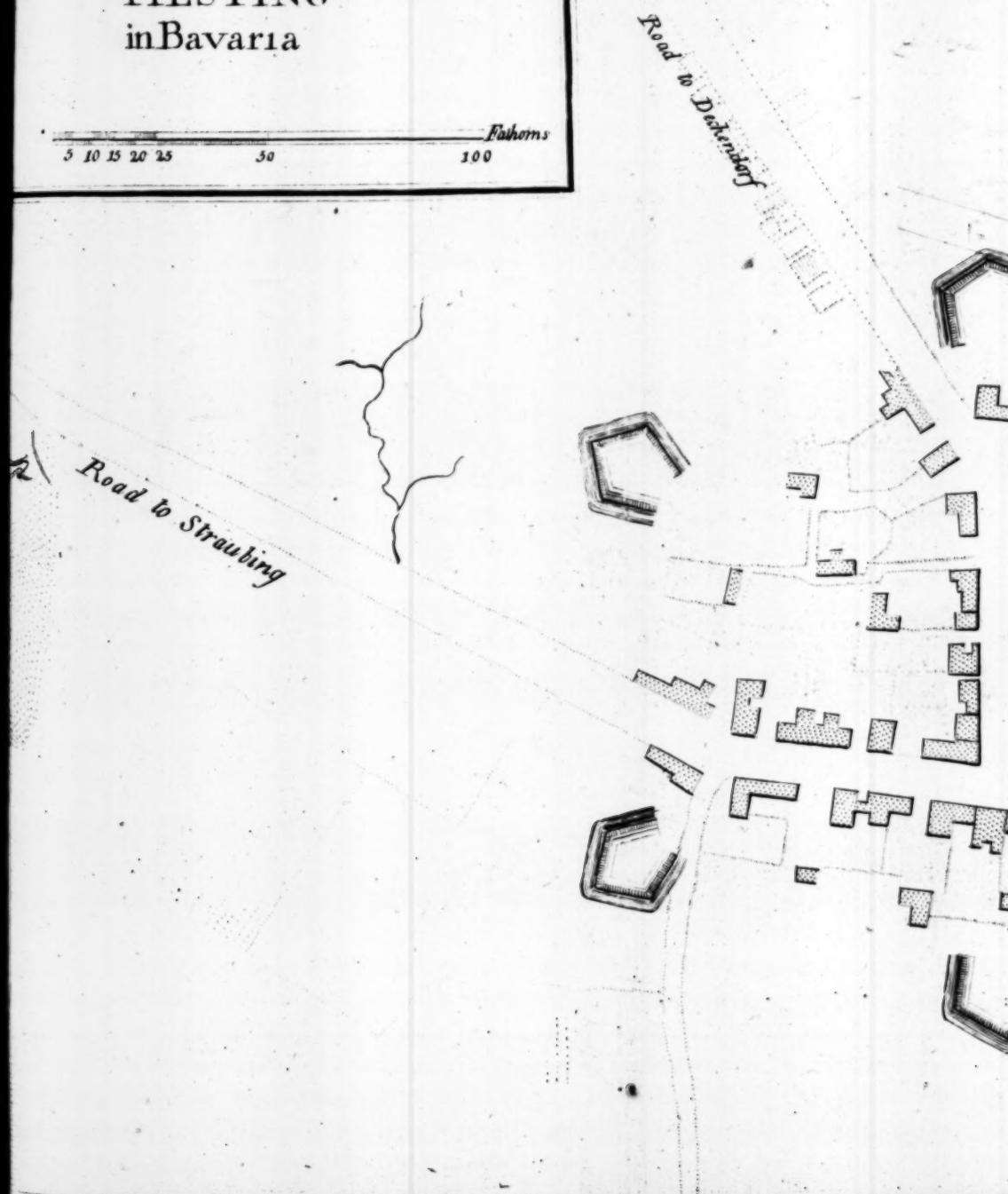
3 10 15 20 25
Fathoms 50



SMALL TOWNS TO

PILSTING
in Bavaria

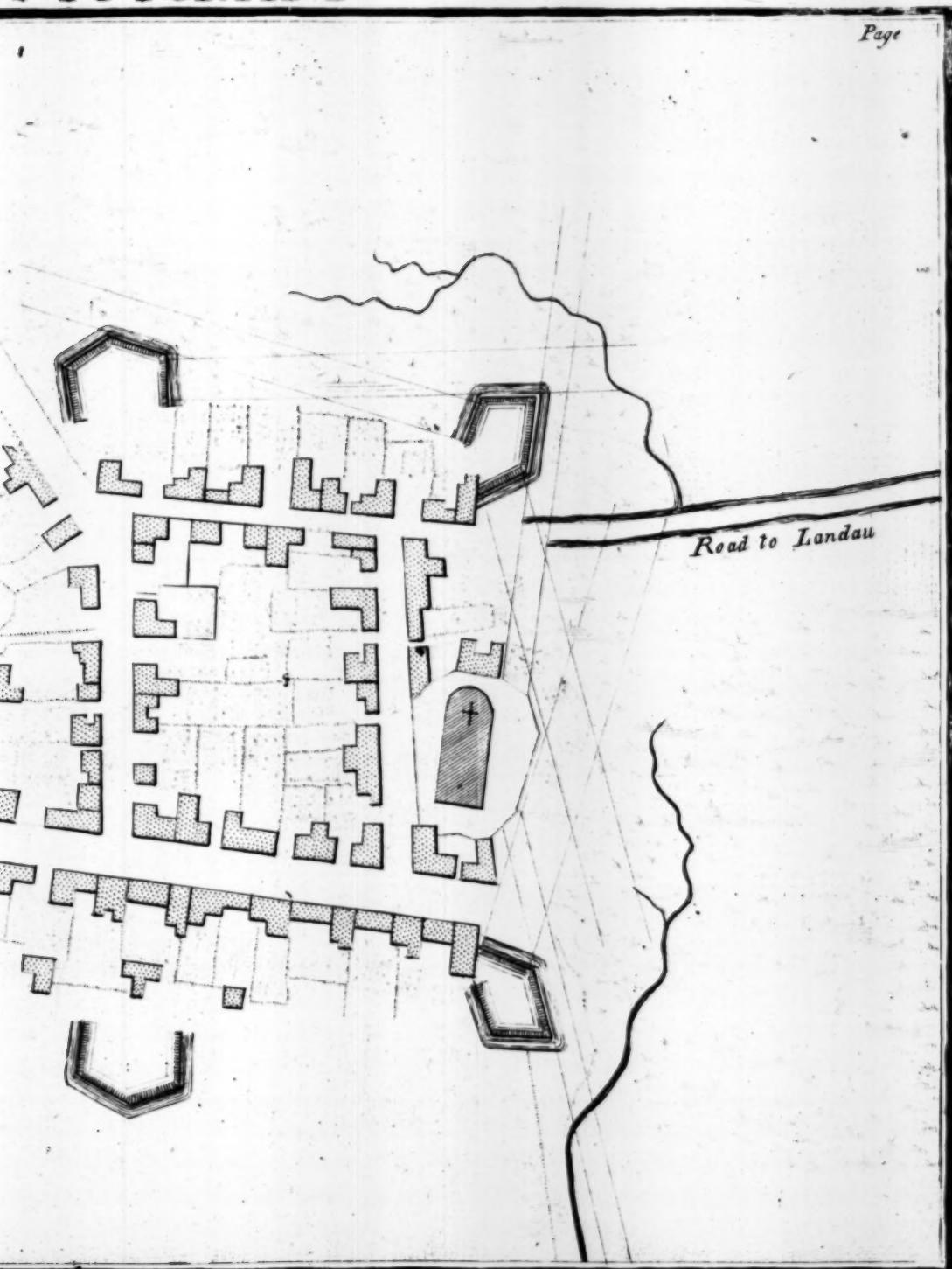
5 10 15 20 25 50 100 Fathoms



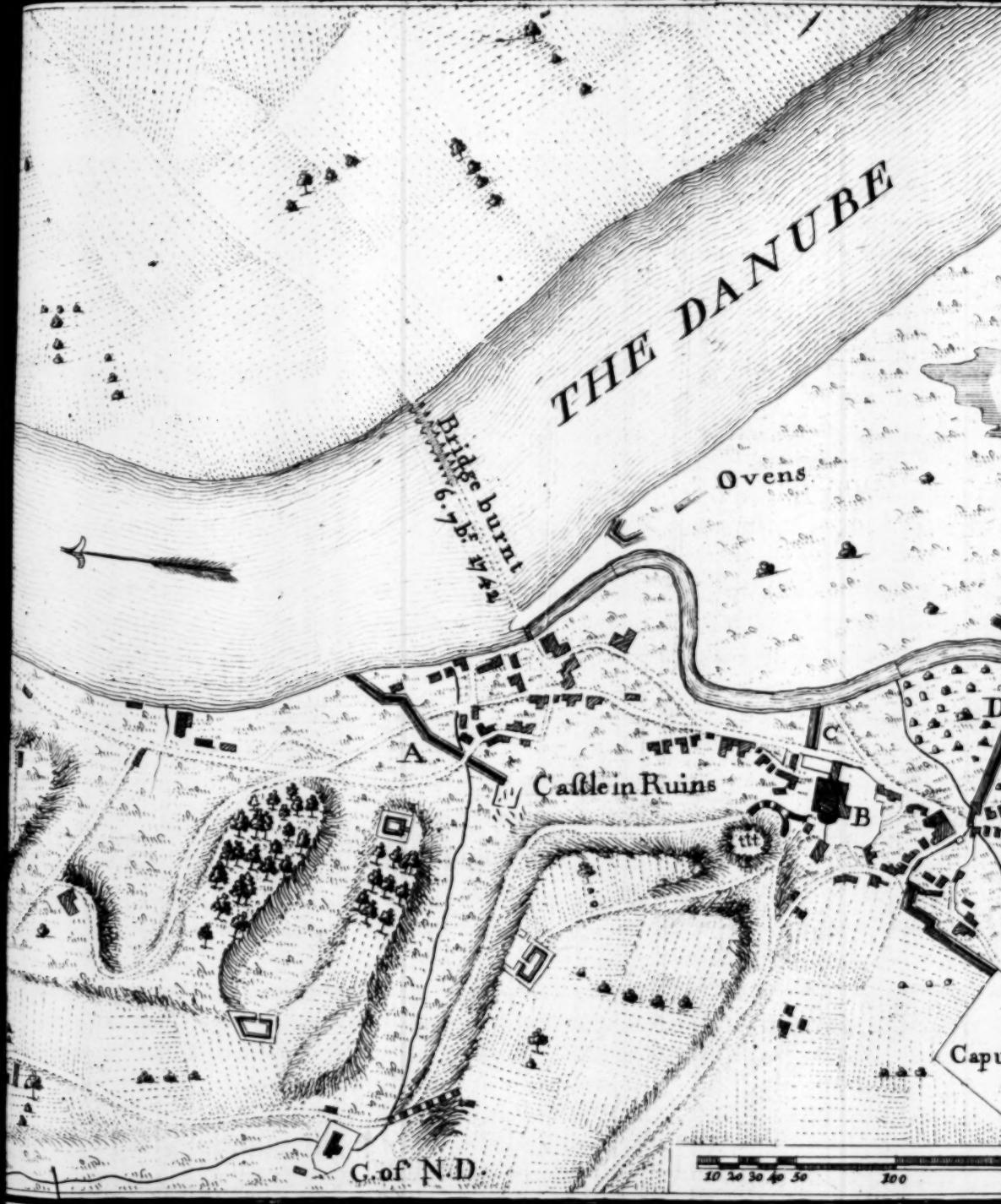
S TO FORTIFY

Plate 11

Page



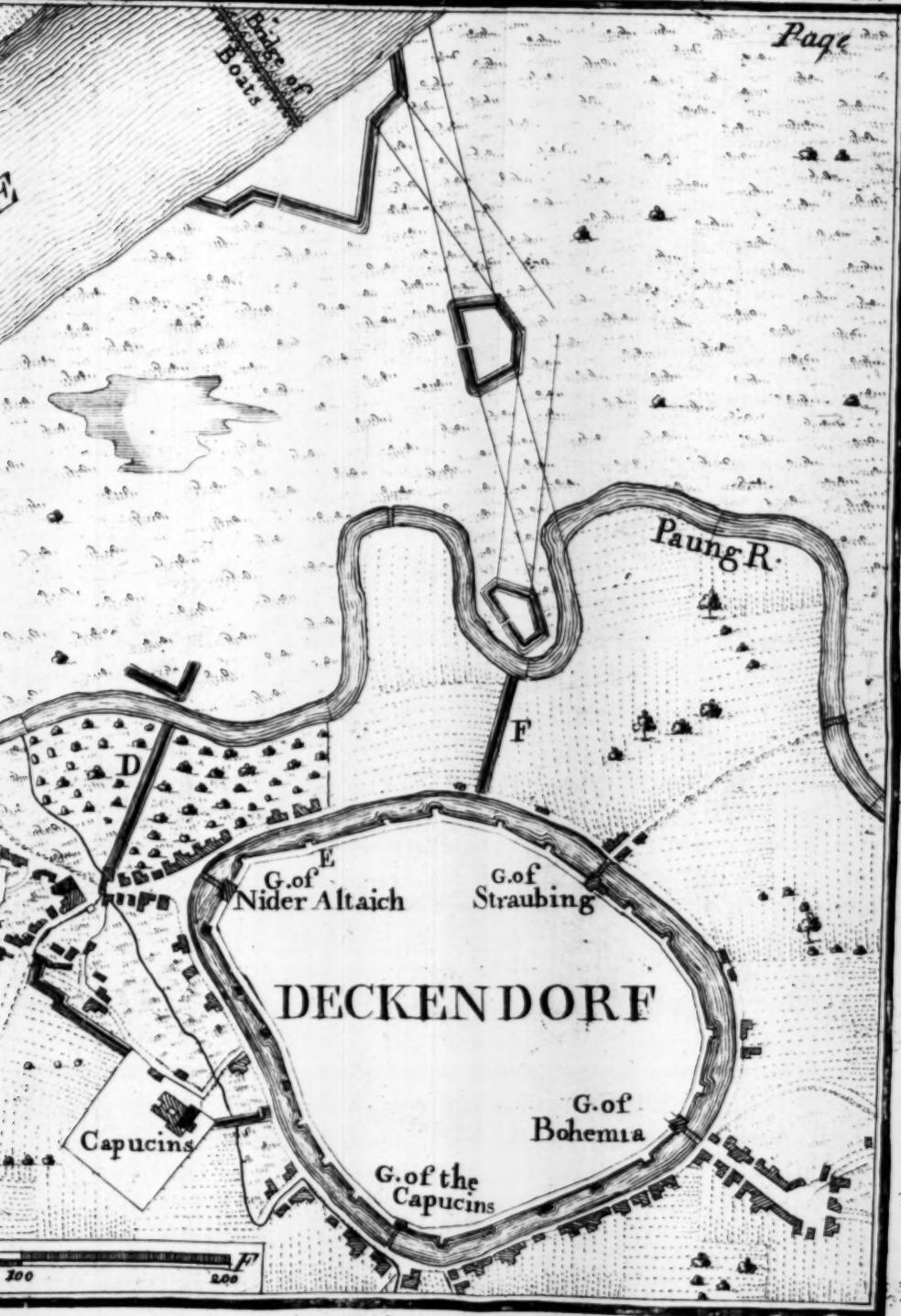
COMMUNICATI



LOCATIONS

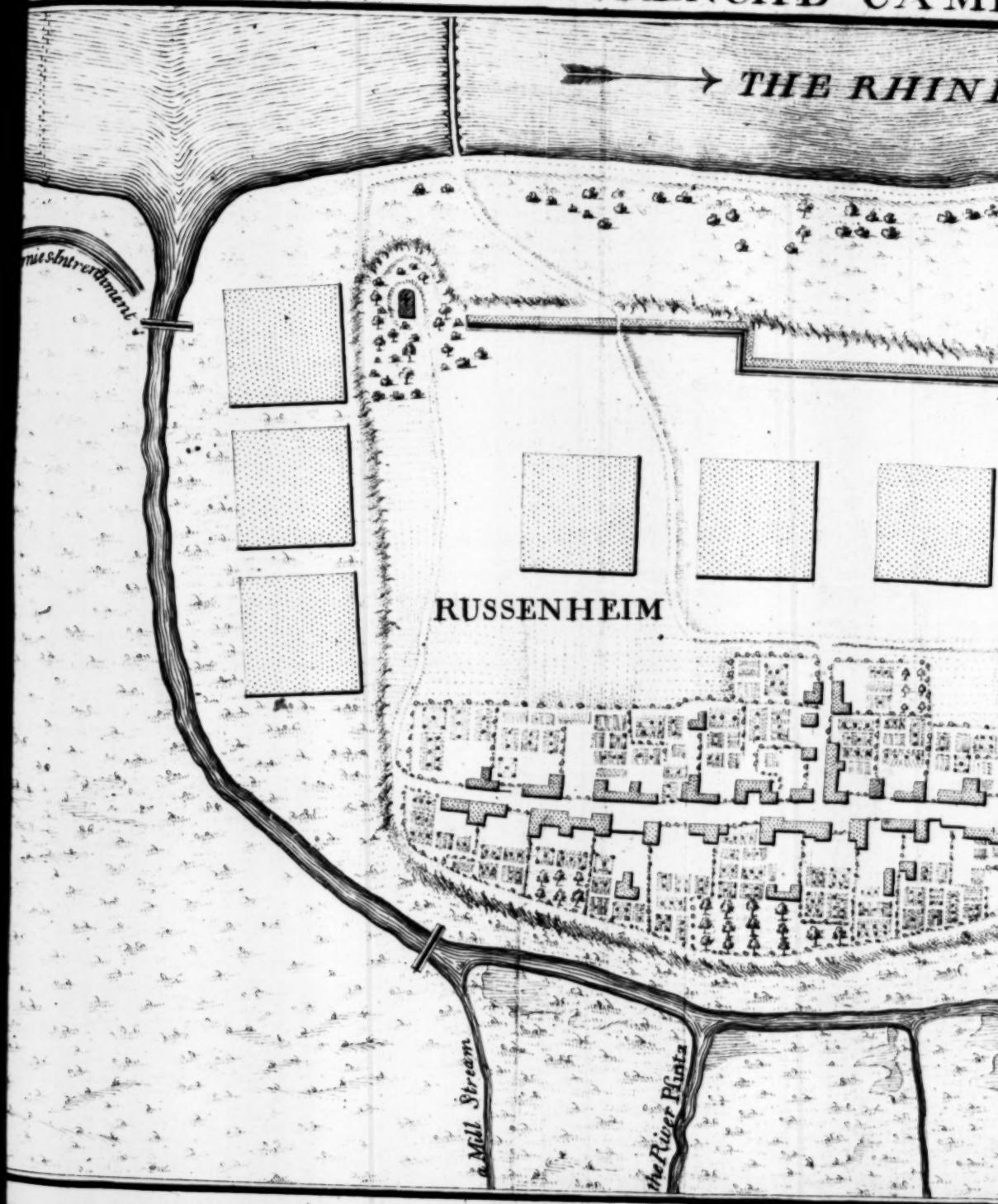
Plate 12.

Page



I. IN TRENCH'D CAMPS

→ THE RHINE

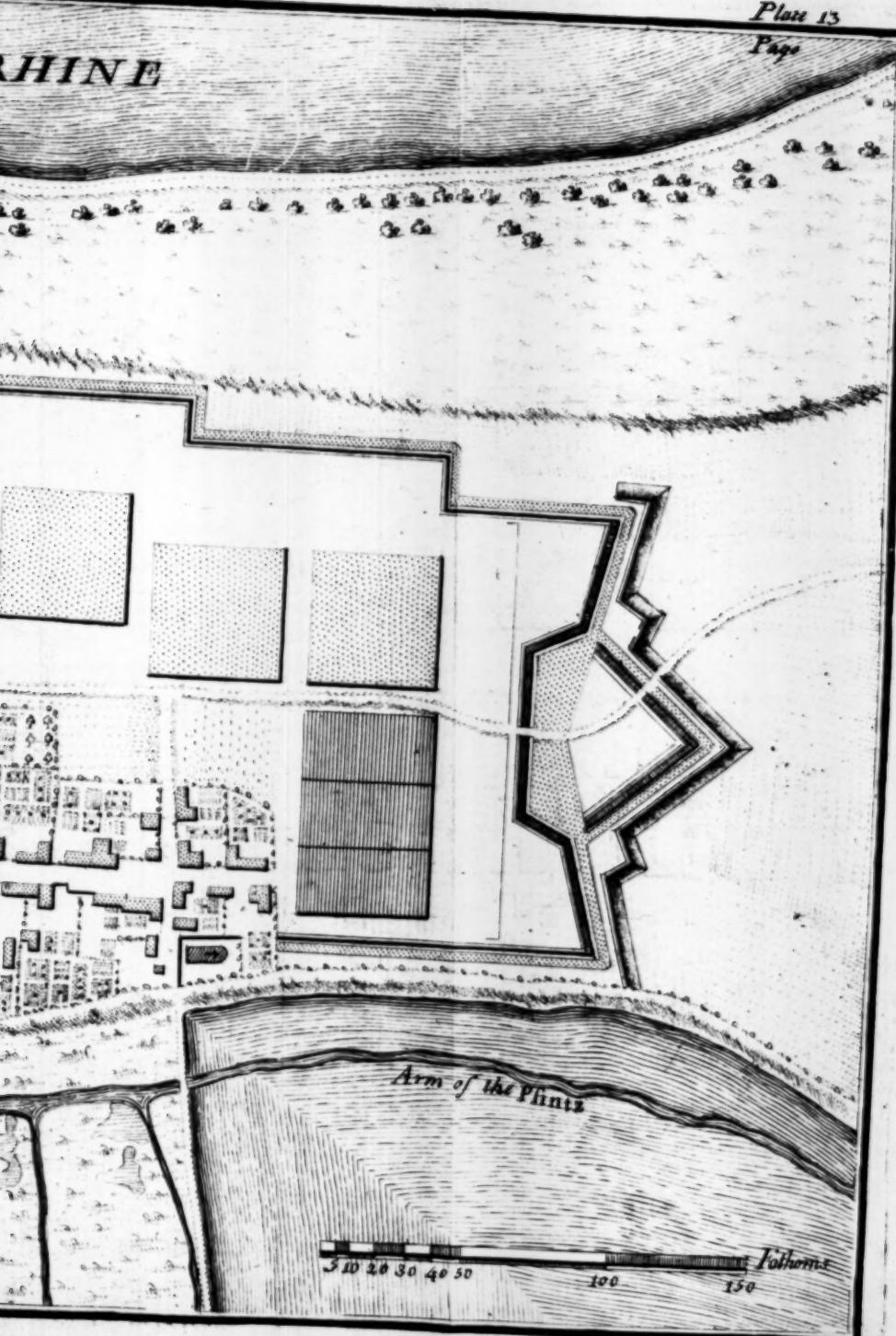


CAMPS.

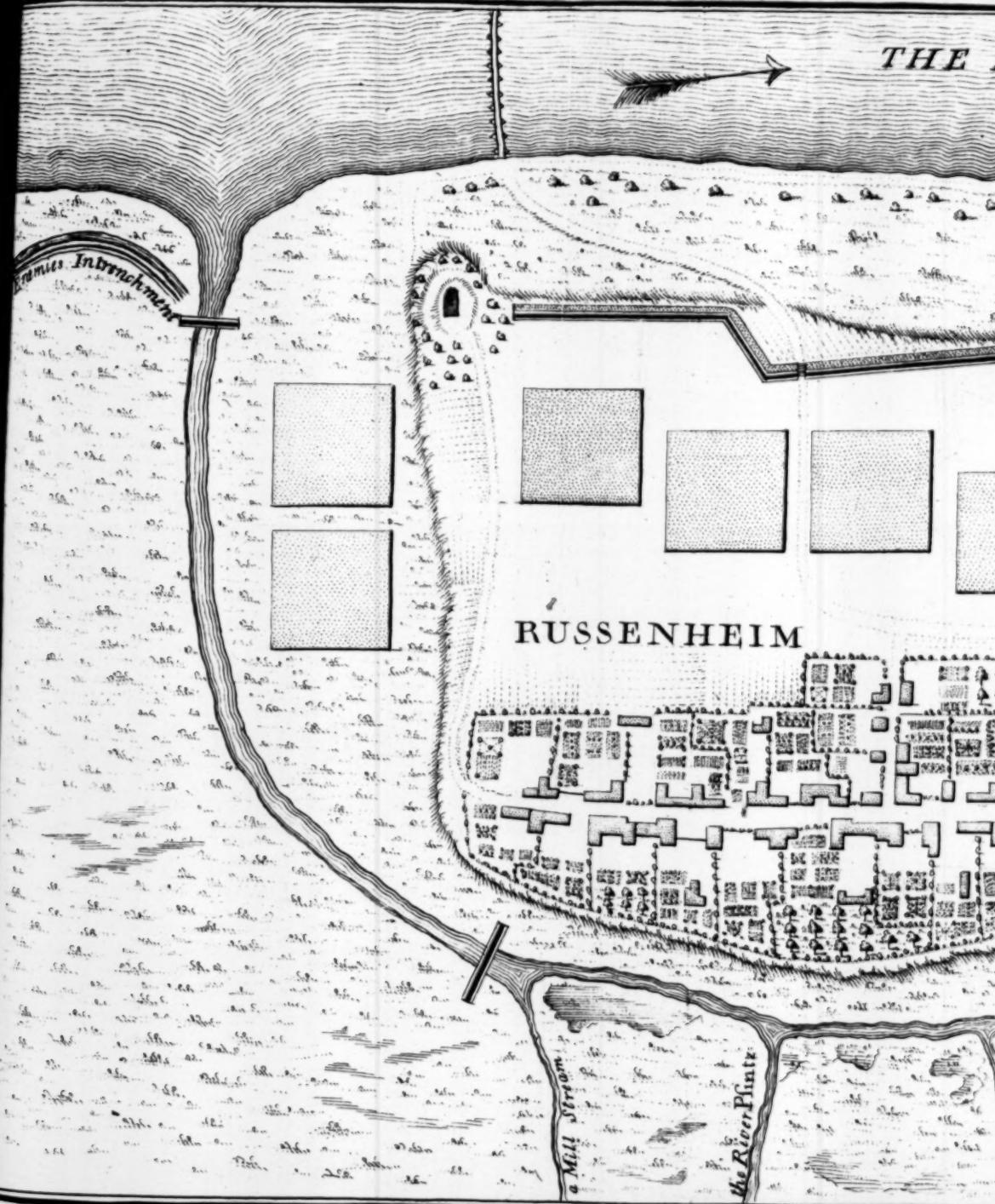
RHINE

Plate 13

Page



II. INTRENCH'D C

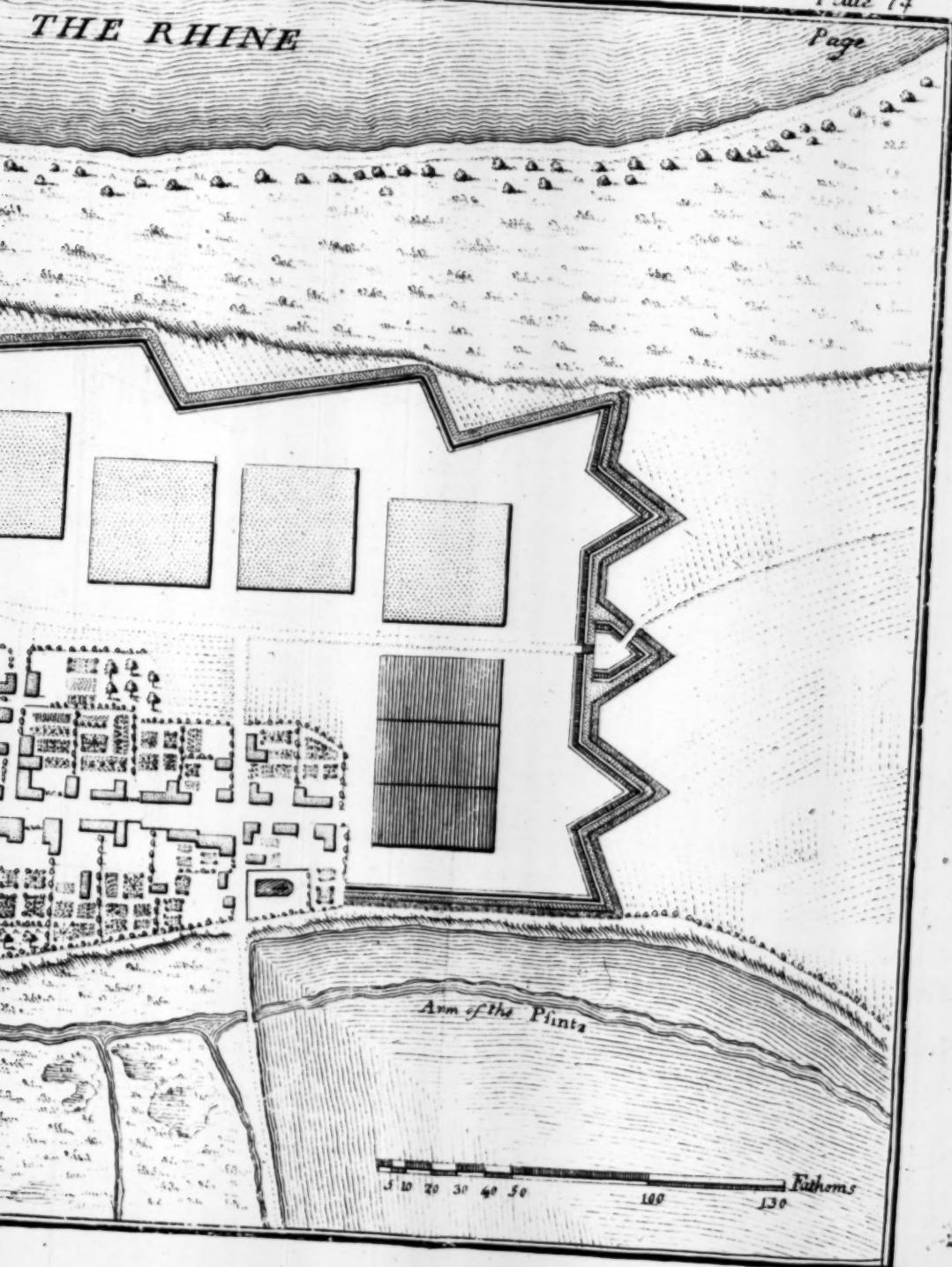


ARMED CAMPS

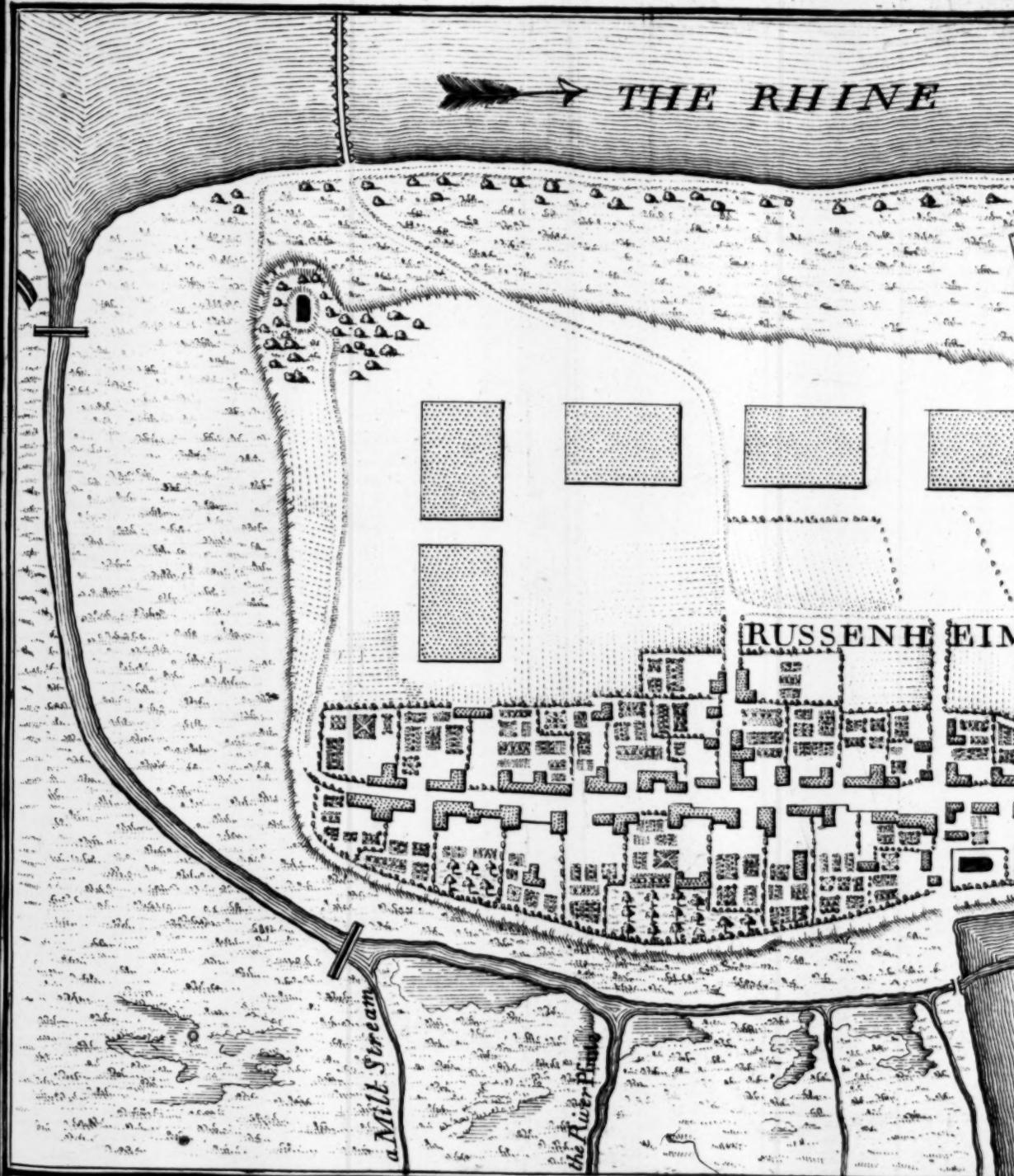
THE RHINE

Plate 14

Page

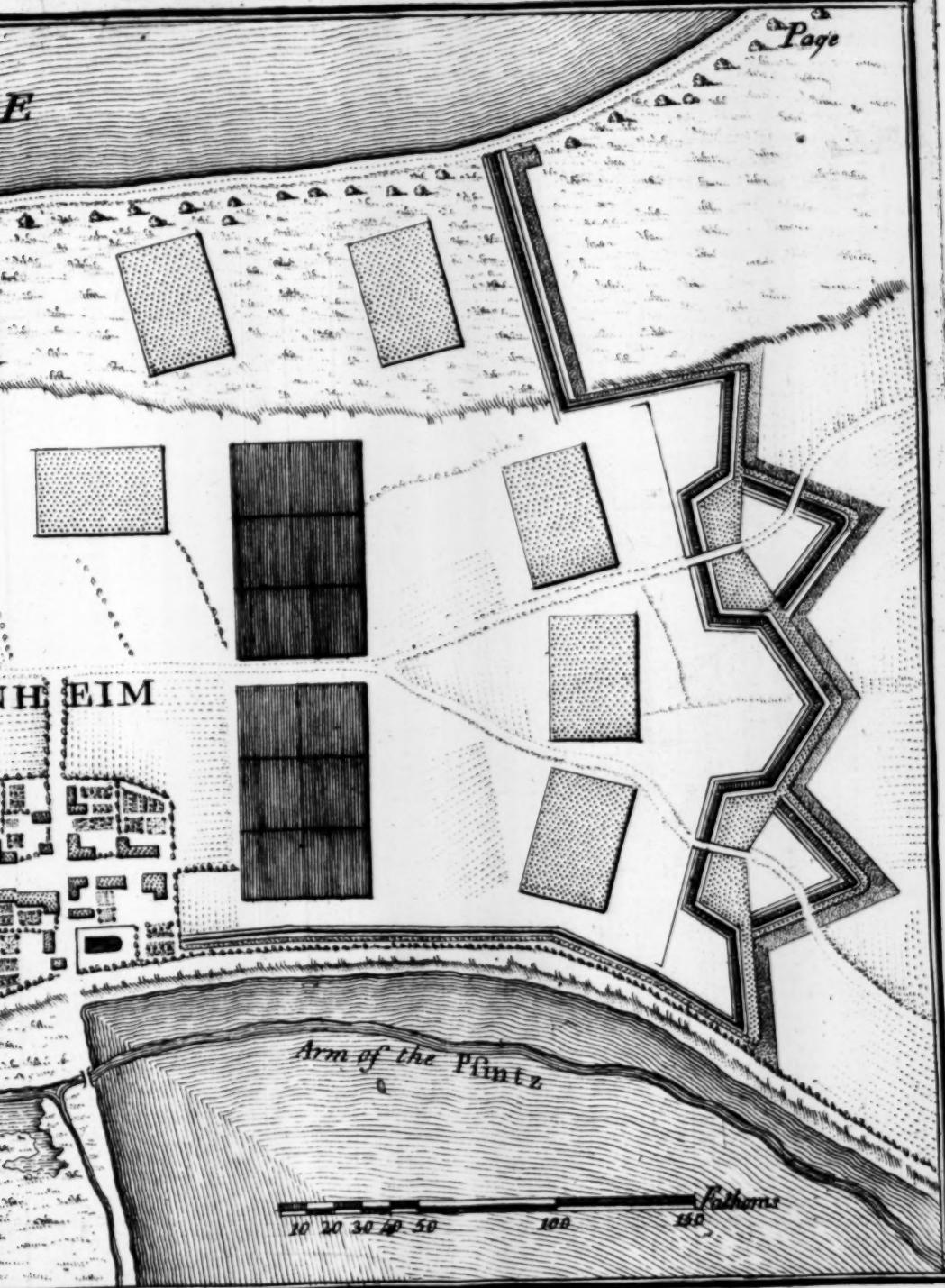


III. INTRENCH'D

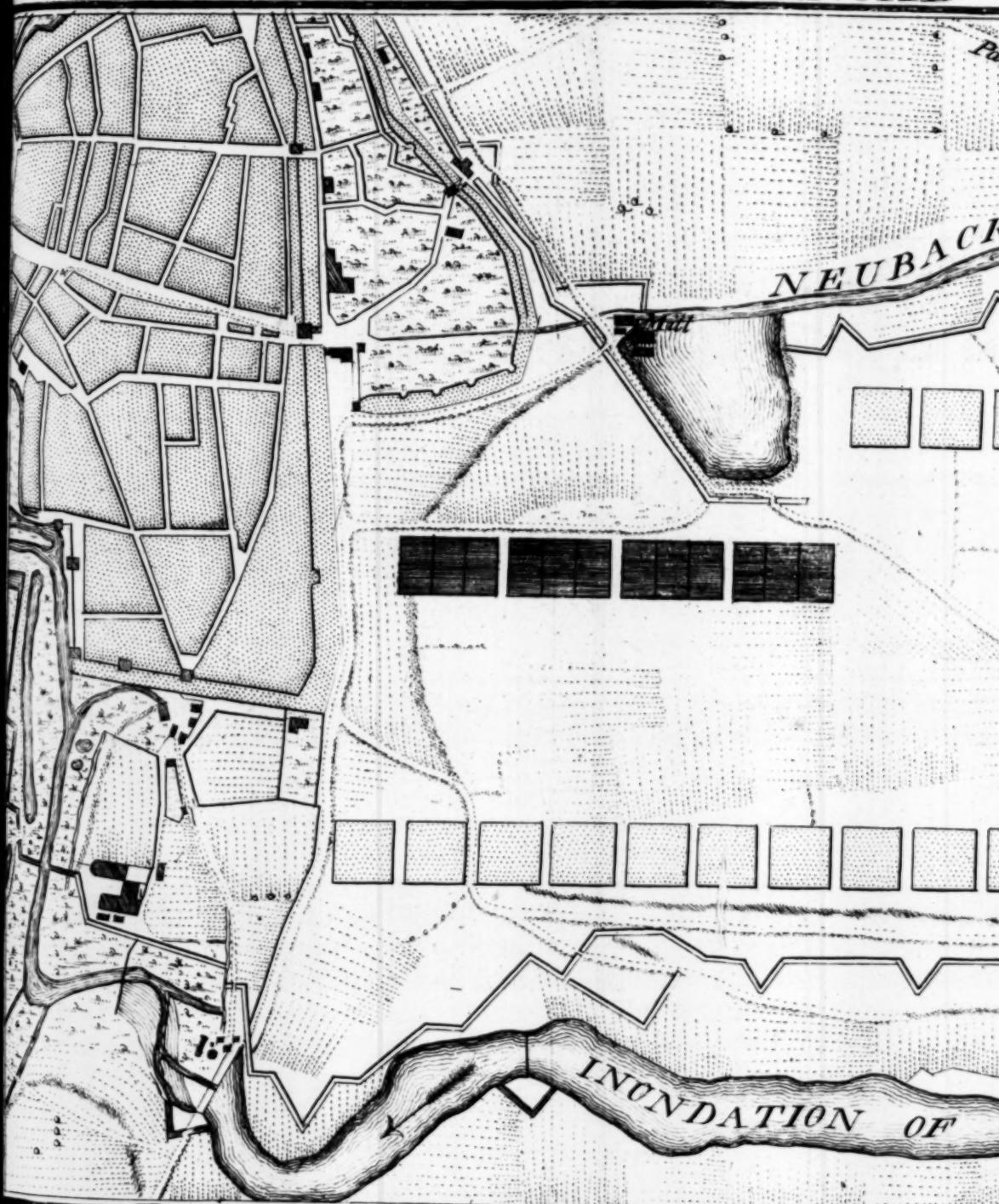


CH'D CAMPS

Plate 15.



IV. INTRENCH'D C

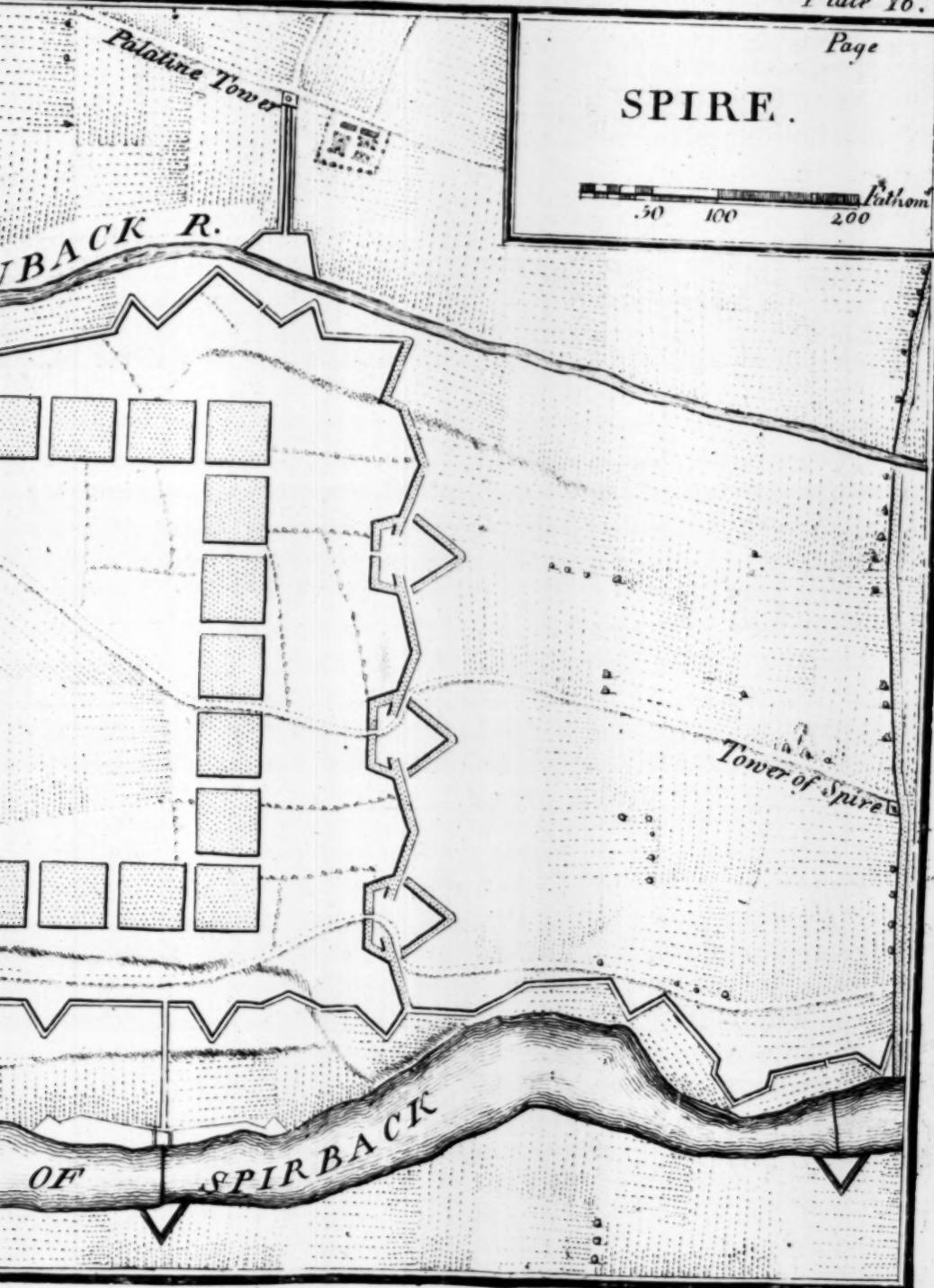
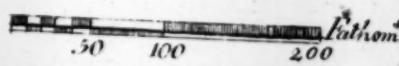


HD CAMPS

Plate 16.

SPIRE.

Page



LINES WITH R

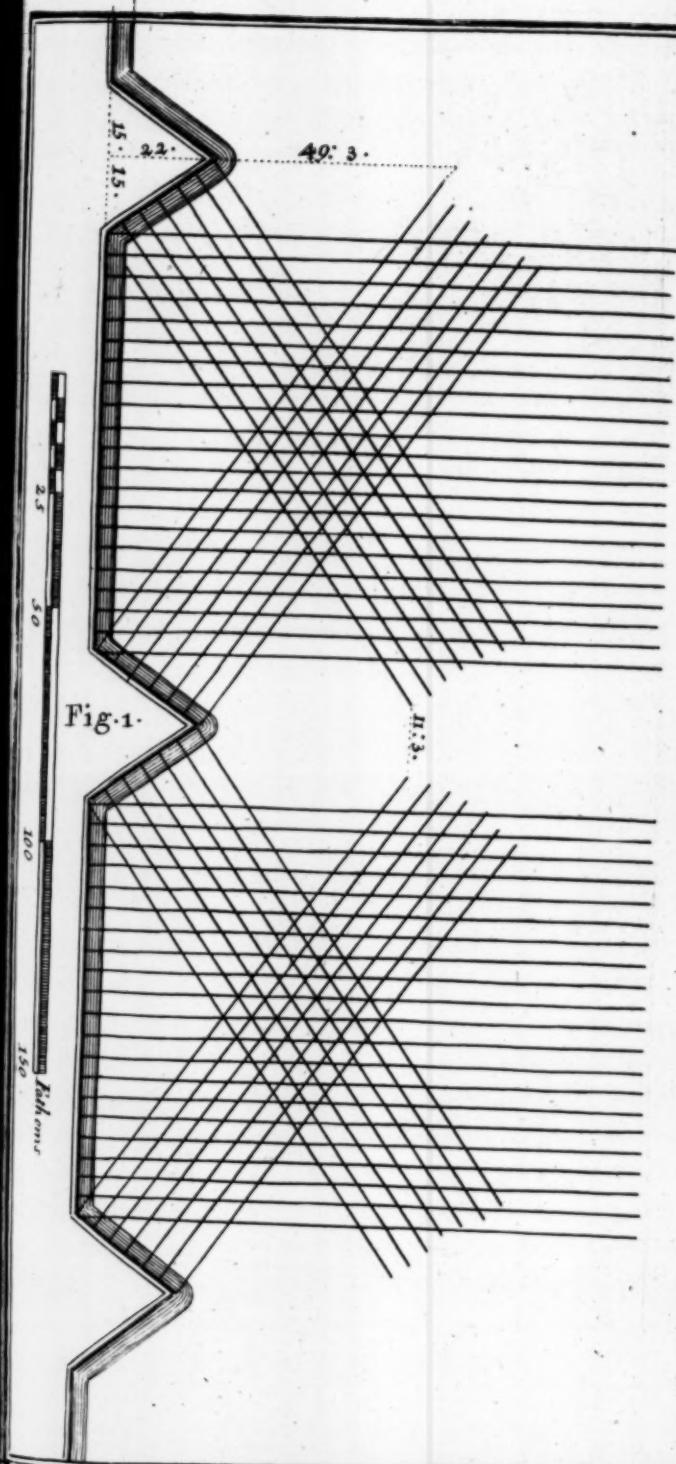


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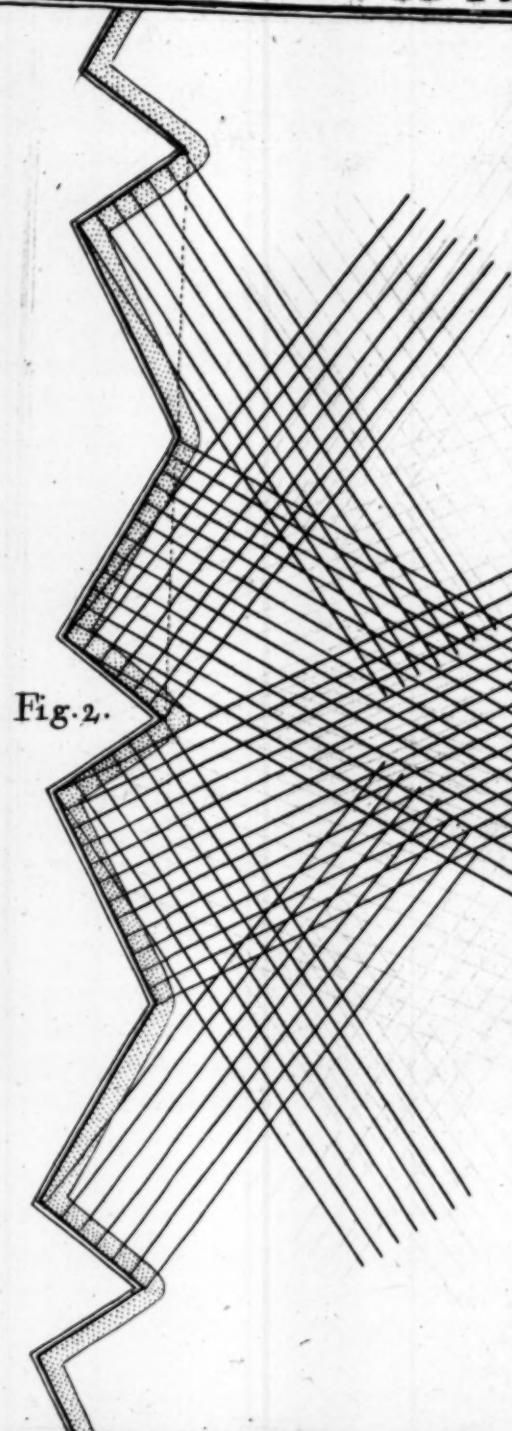
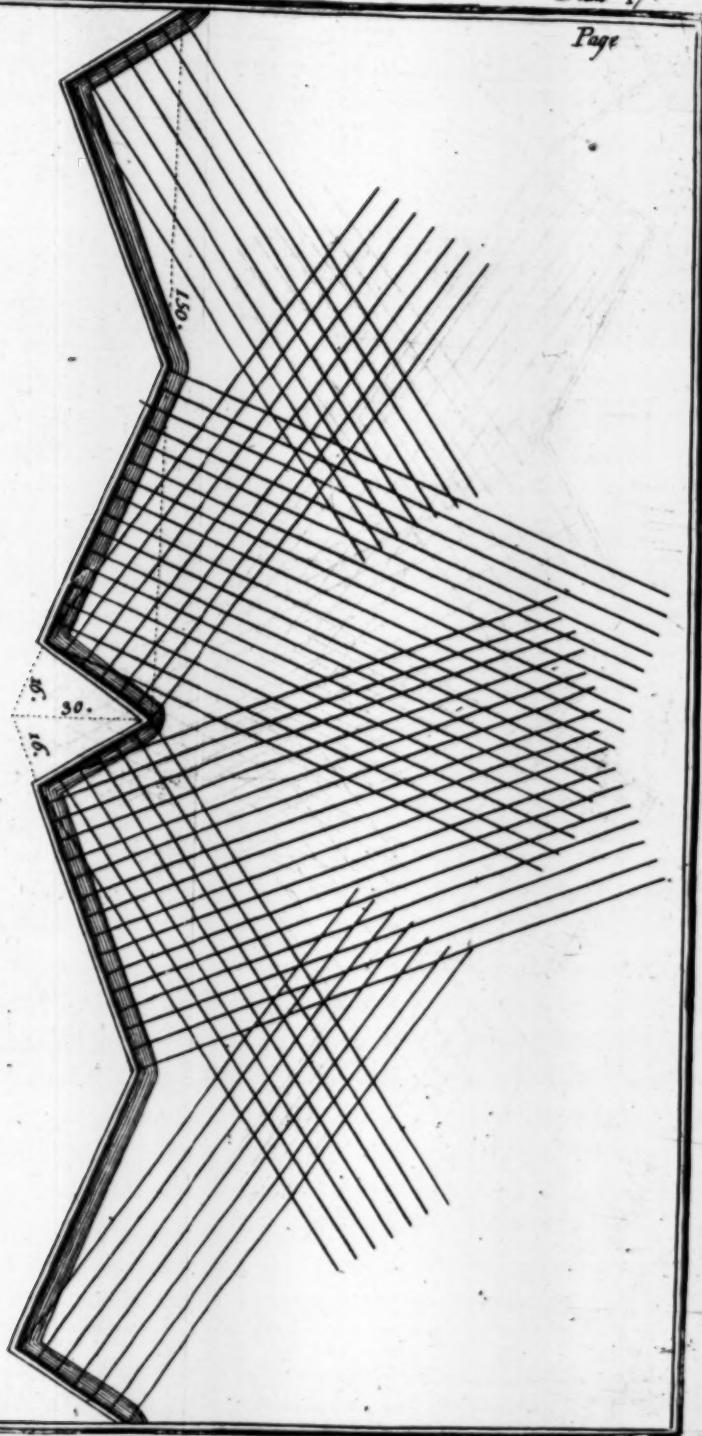


Fig. 2.

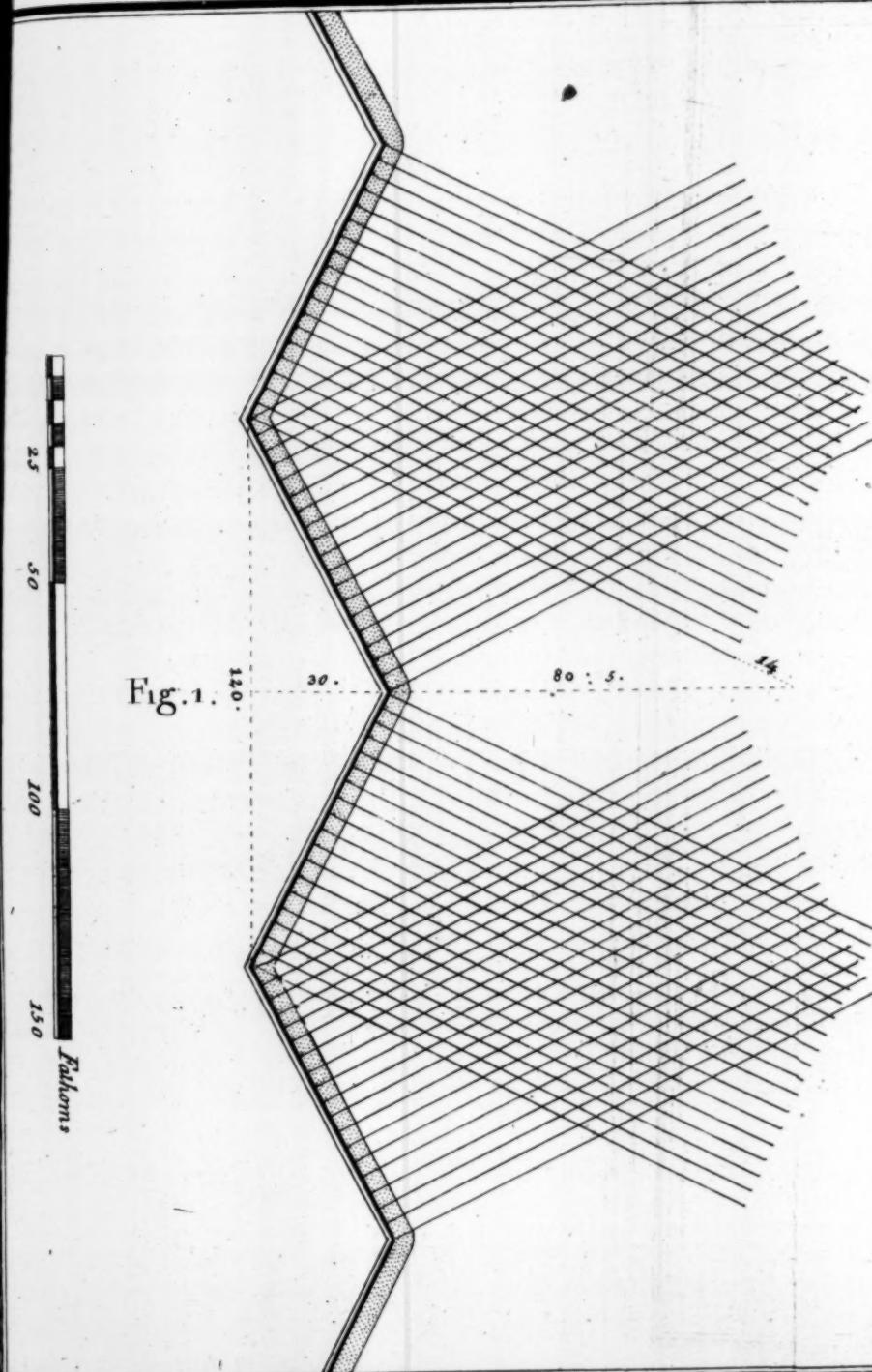
TH REDANS

Plate 17.

Page



LINES WITH TENA

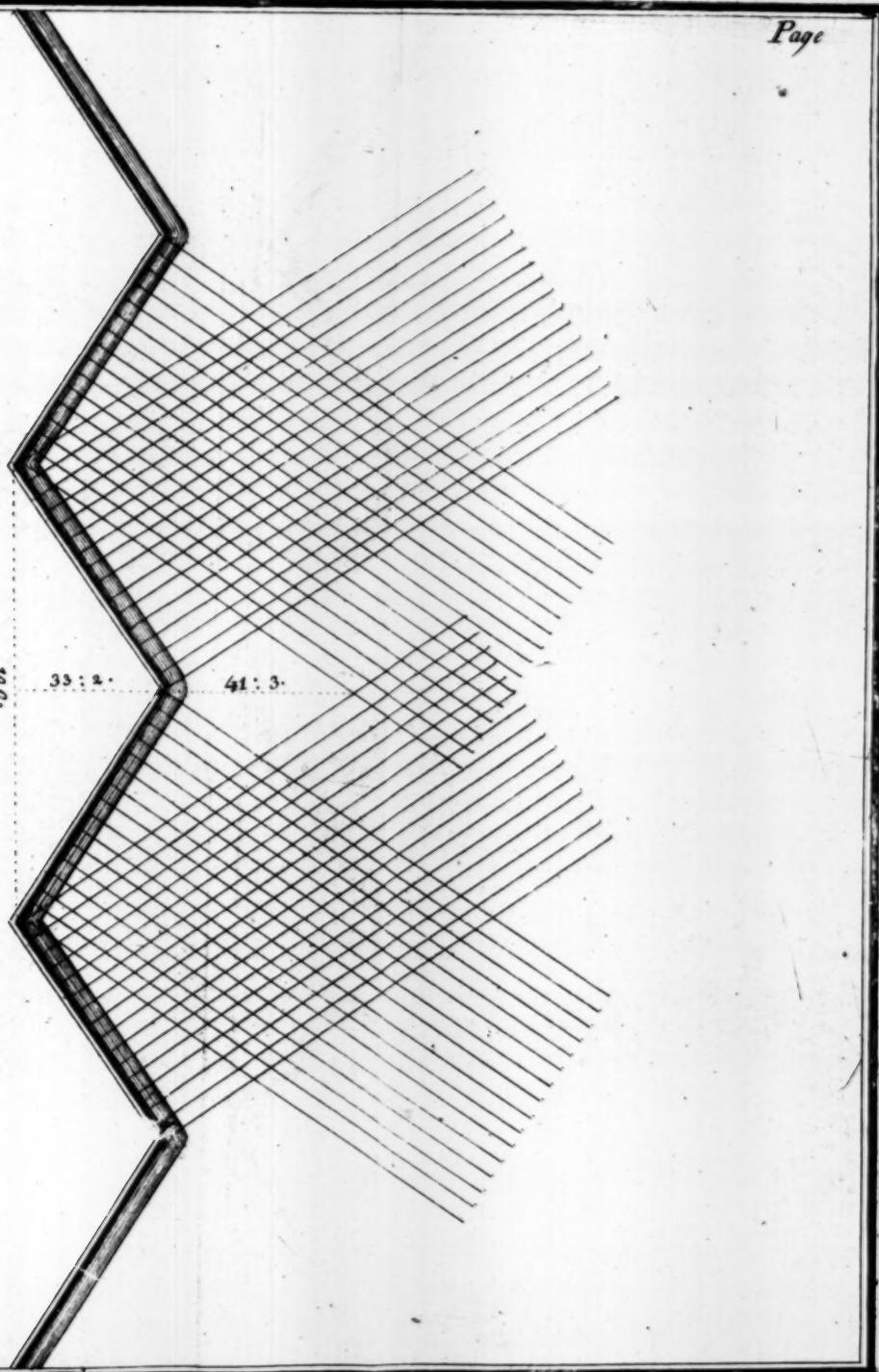


TENAILLES

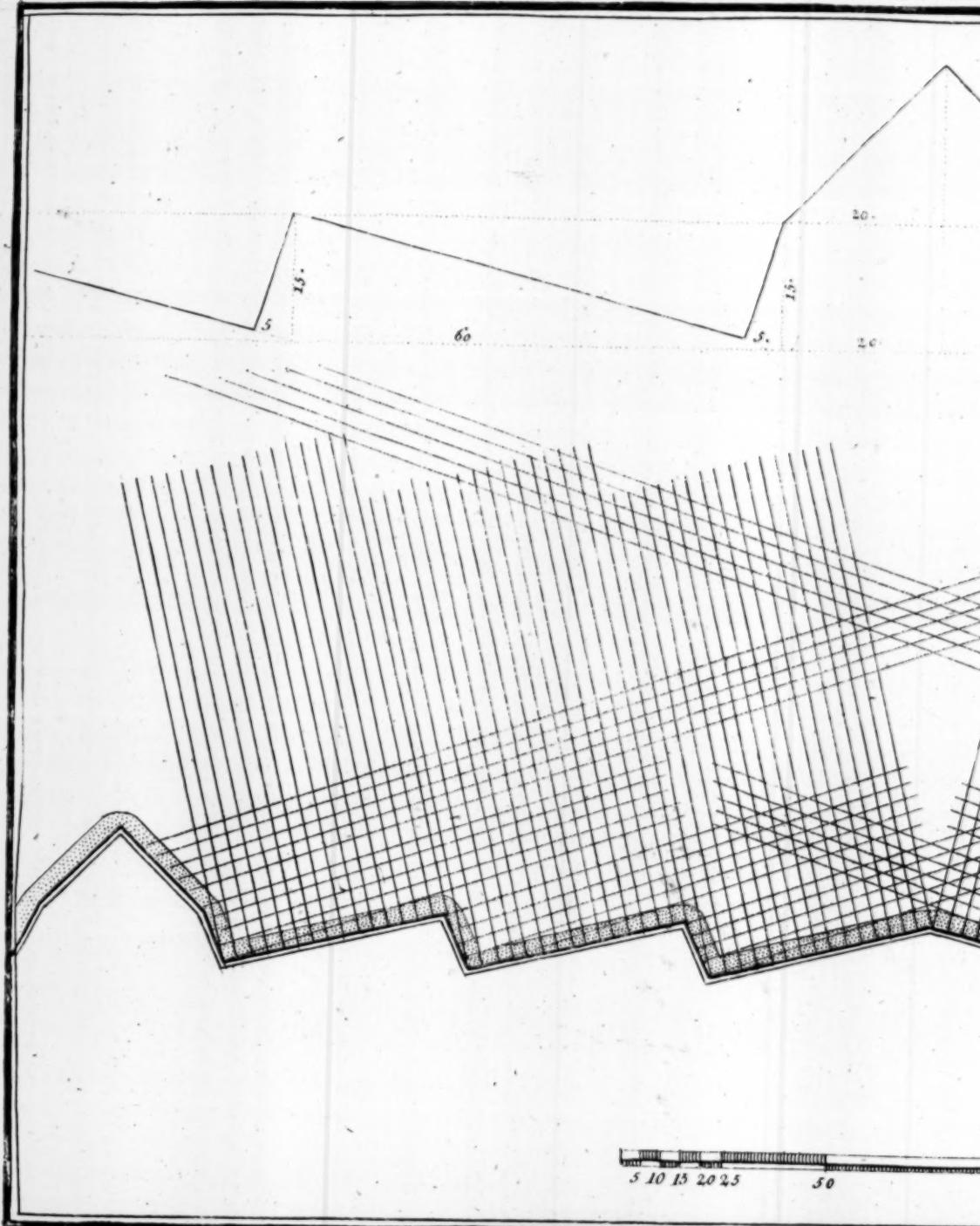
Plate 18

Page

Fig. 2.



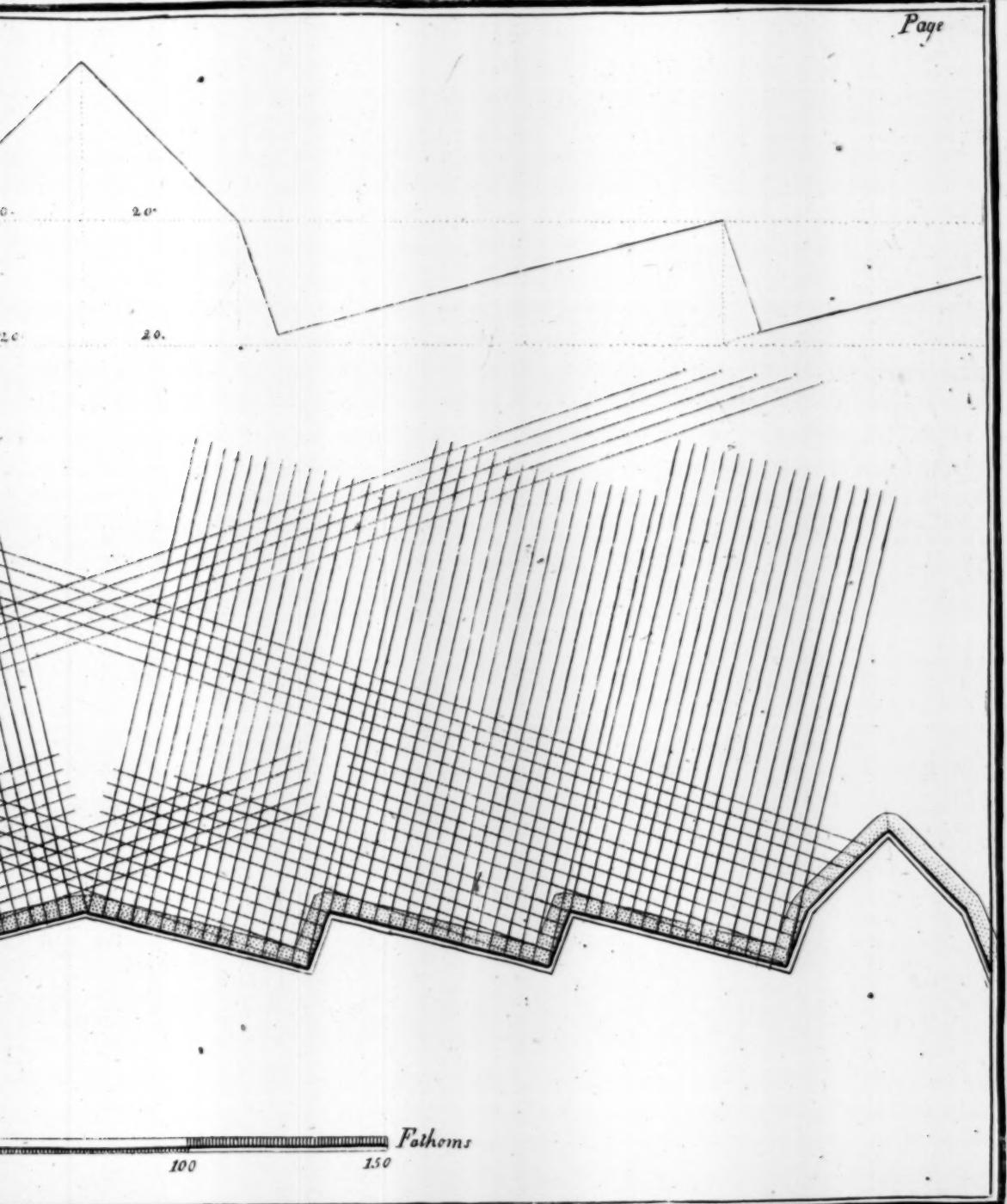
LINES A CREEK



CREMAILLERE

Plate 19.

Page



LINES WITH LUN

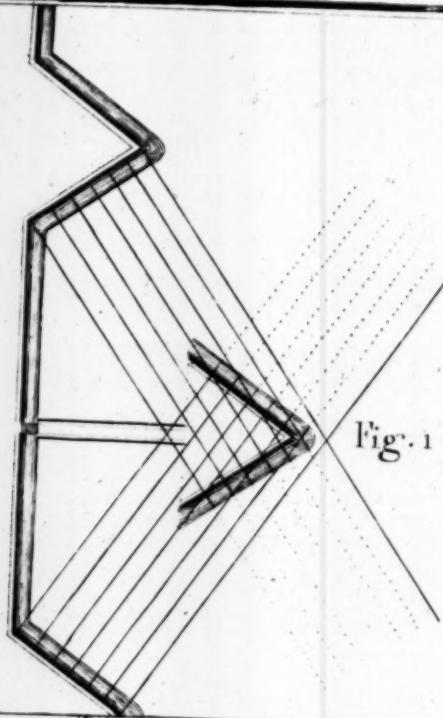


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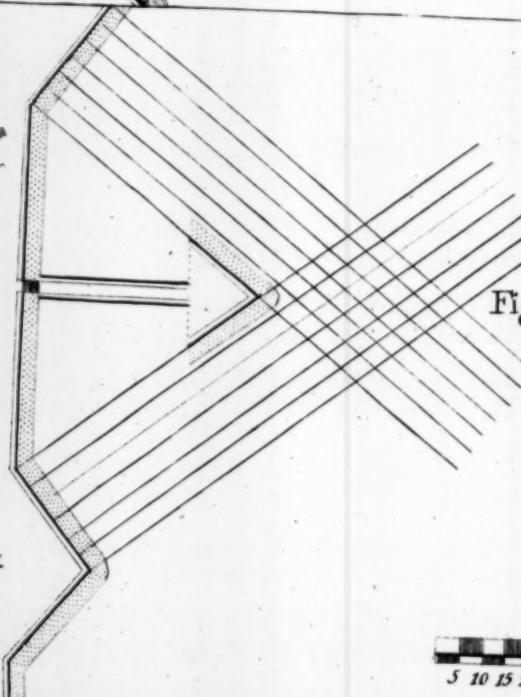


Fig. 2.



Fig. 3.

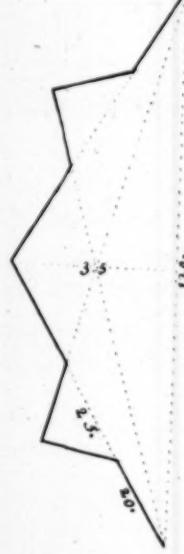


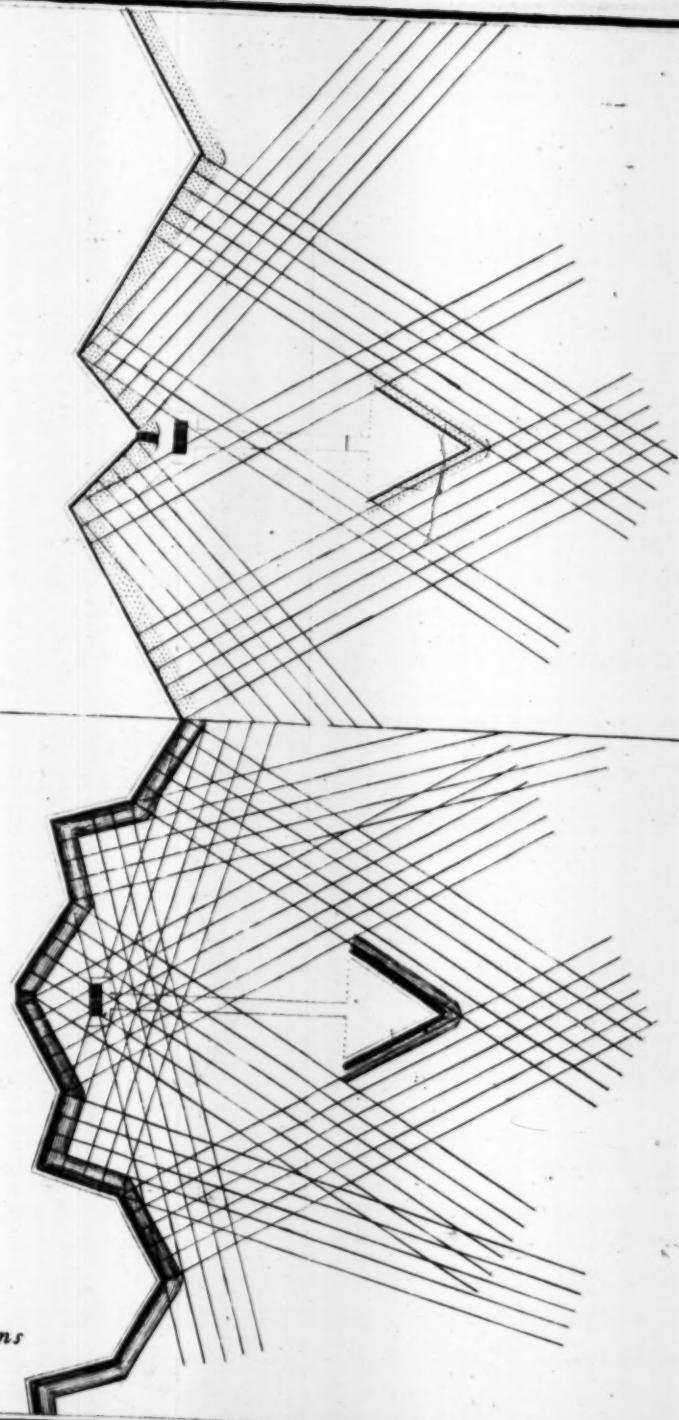
Fig. 4.

5 10 15 20 25. 50 100 150

LUNETTES

Plate 201

Page



Fathoms
150

LINES WITH BAST

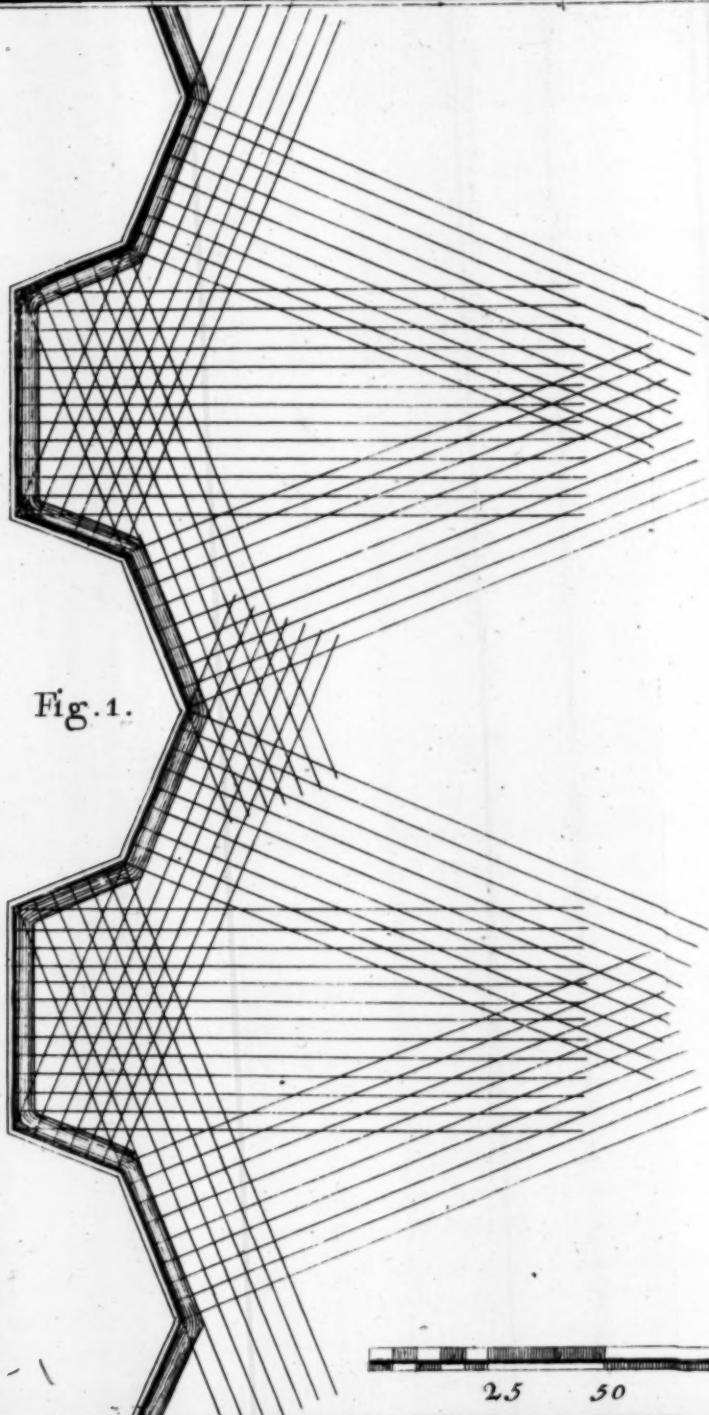


Fig. 1.

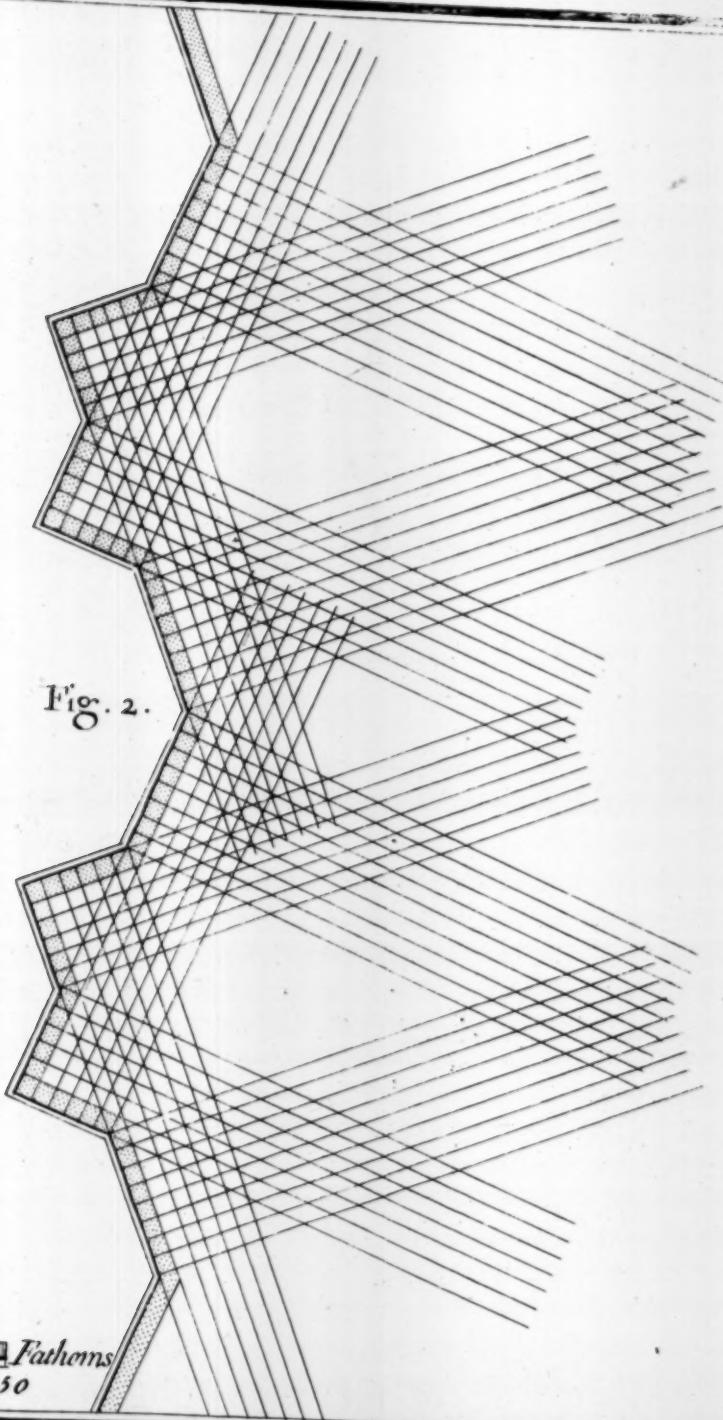
25 50 100

BASTIONS

Plate 41

Page

Fig. 2.



Fathoms
150

OF BASTION

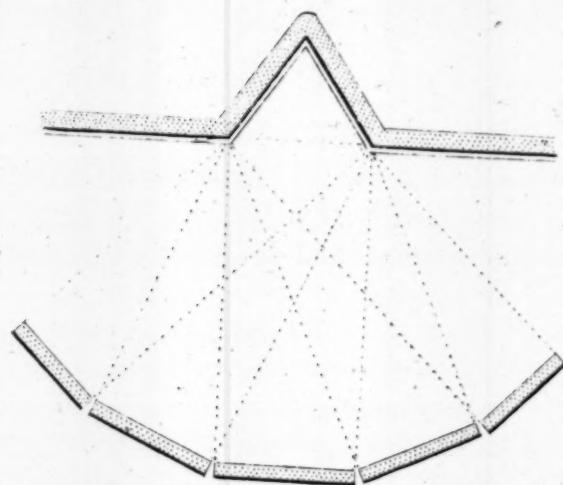
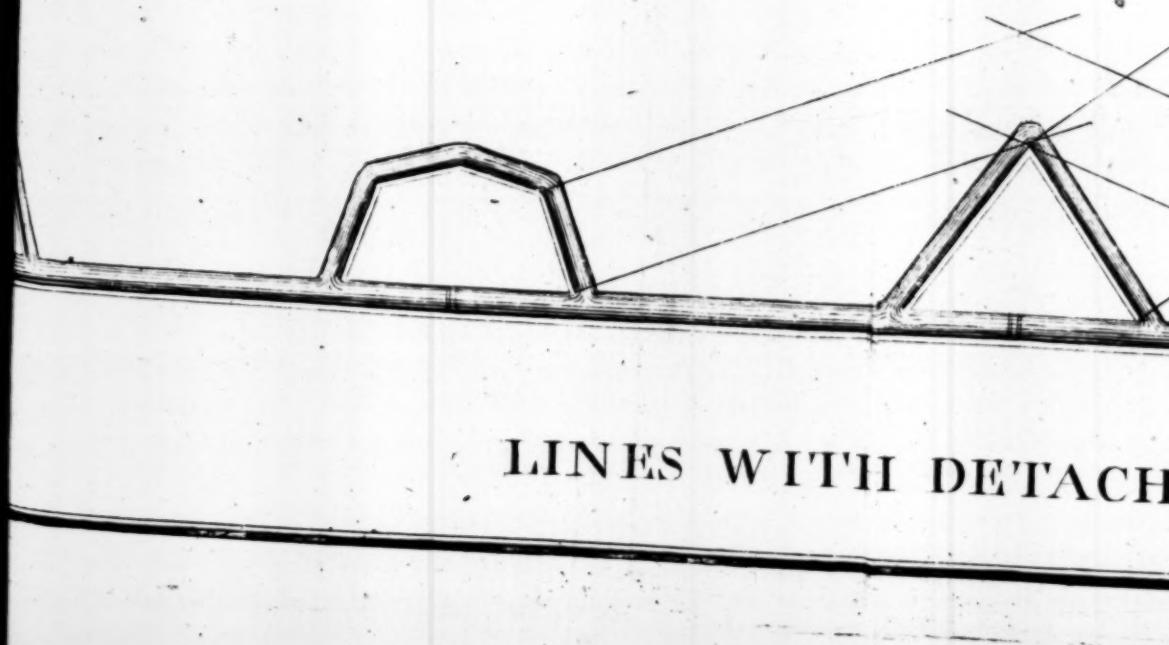


Fig 1.

2.5 5.0 10.0

Fig 2.

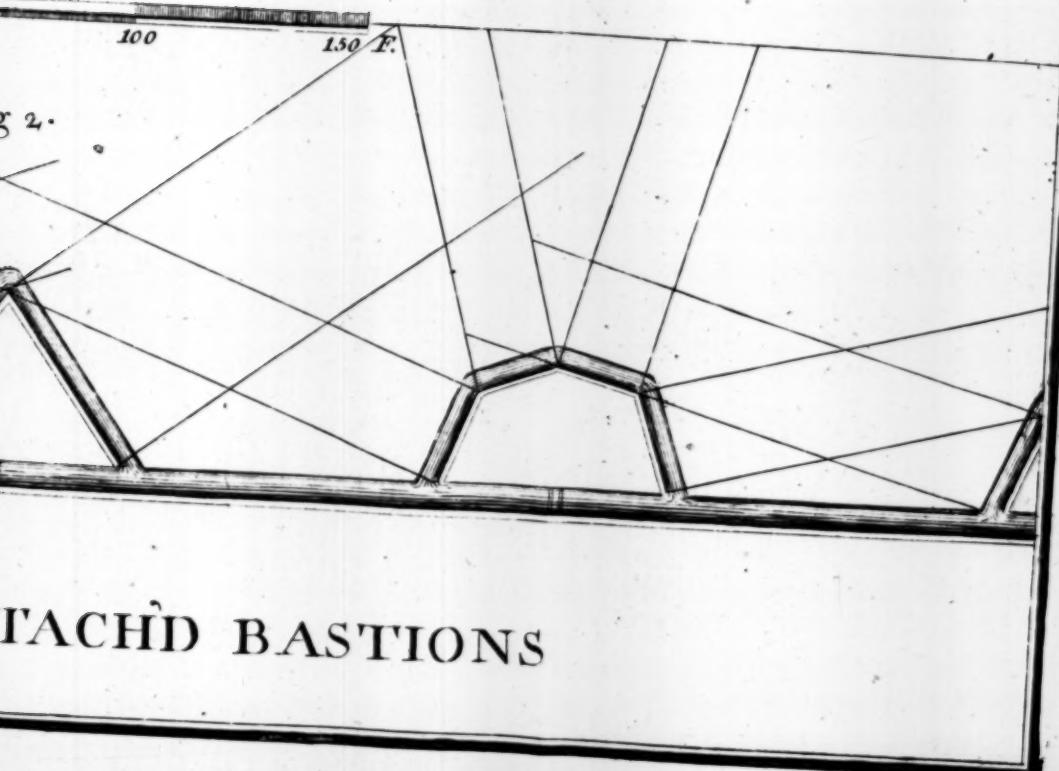
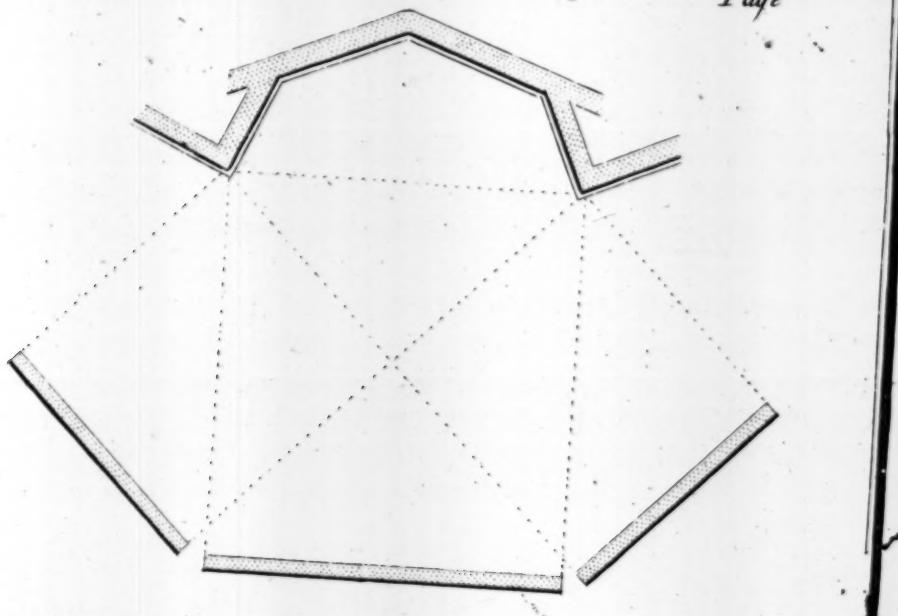


LINES WITH DETACH

BASTIONS

Plate 22.

Page



TACH'D BASTIONS

LINES OF DETACH'D

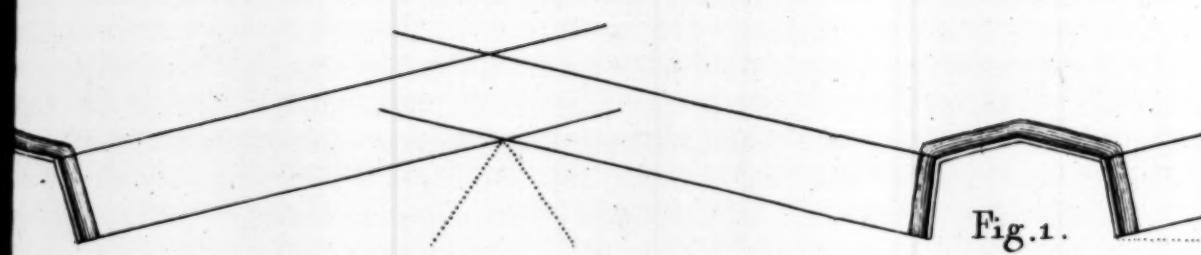


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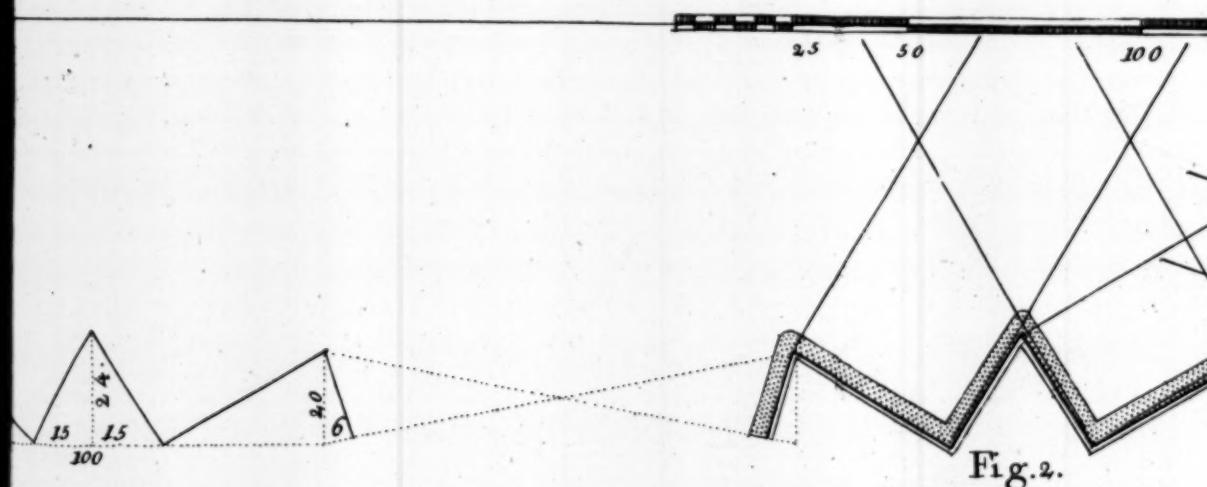


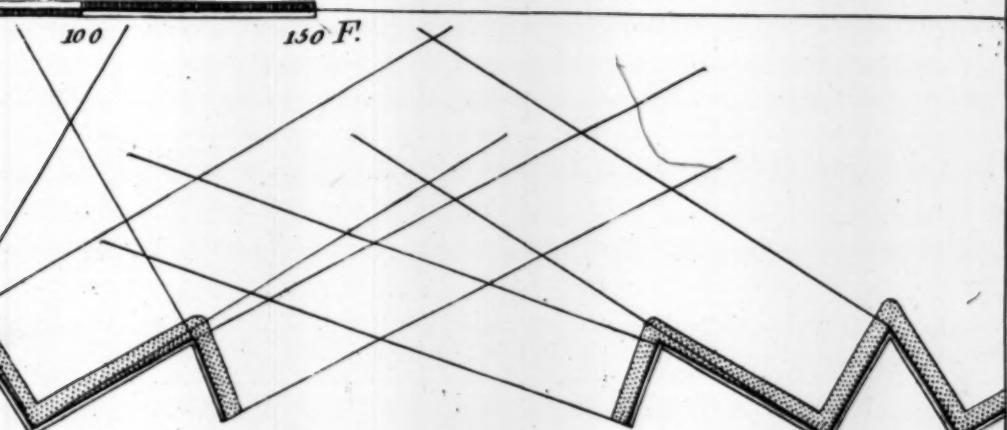
Fig. 2.

LINES DETACH'D IN

A CH'D WORKS

Plate 23

Page

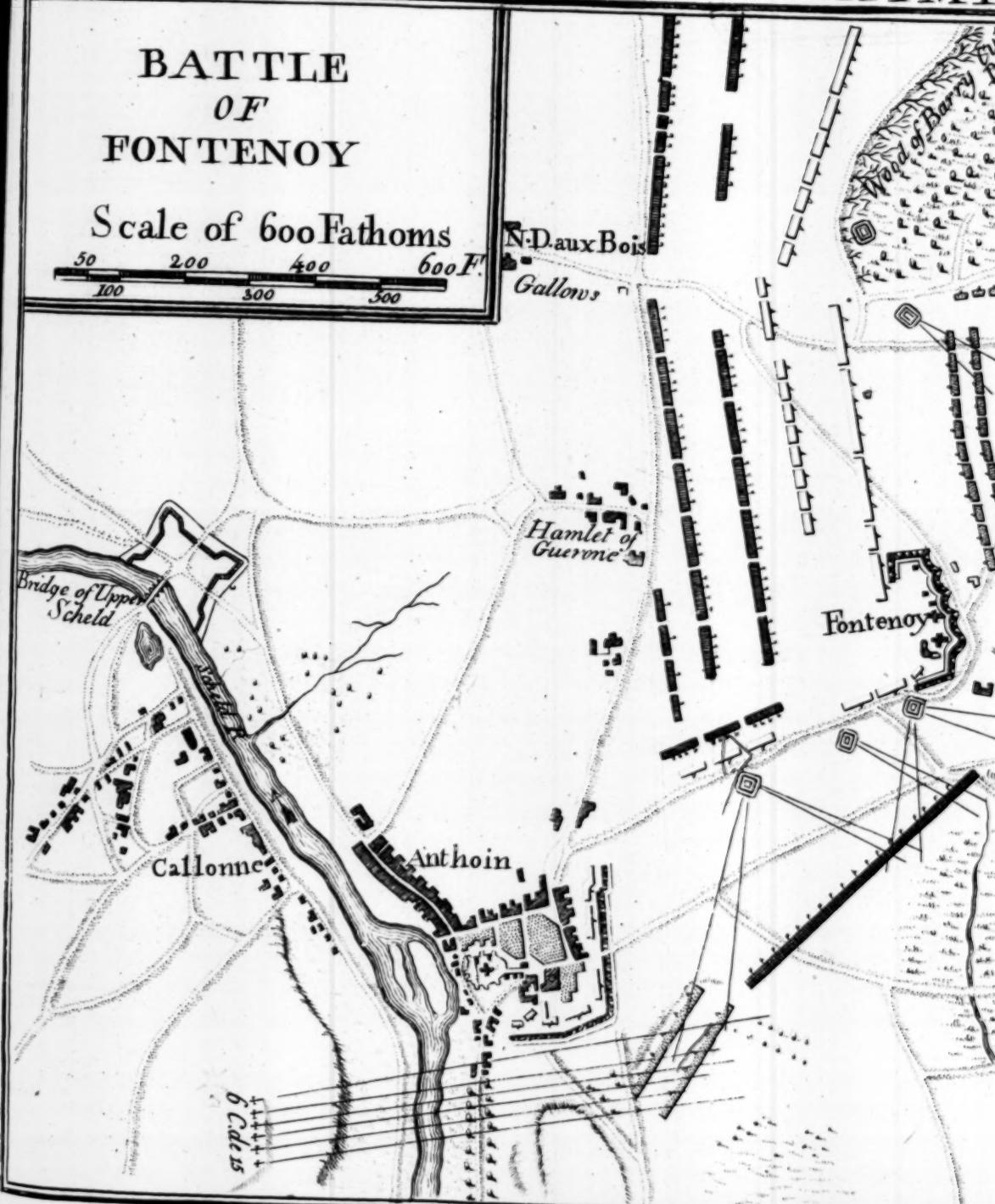


D IN PARTS

EXAM

BATTLE
OF
FON TENOY

Scale of 600 Fathoms



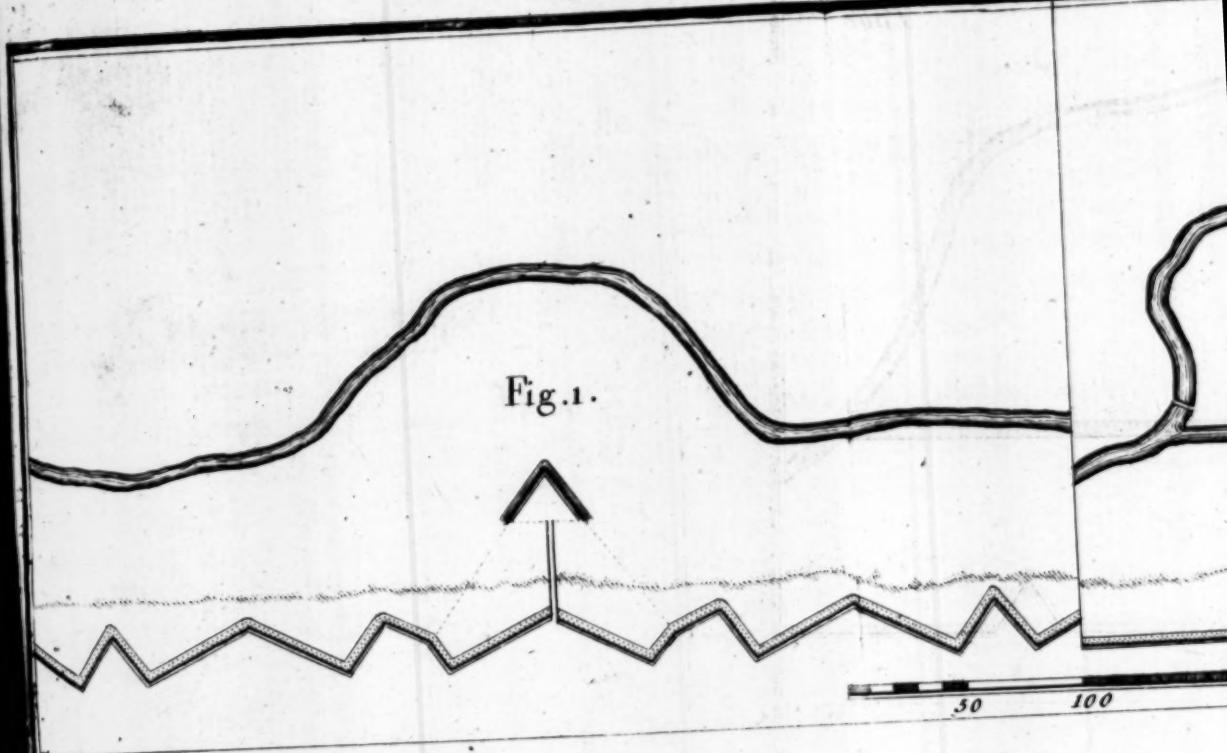
AMPLE

Plate 24.

Page



LINES COVER'D BY



OF SLUICES

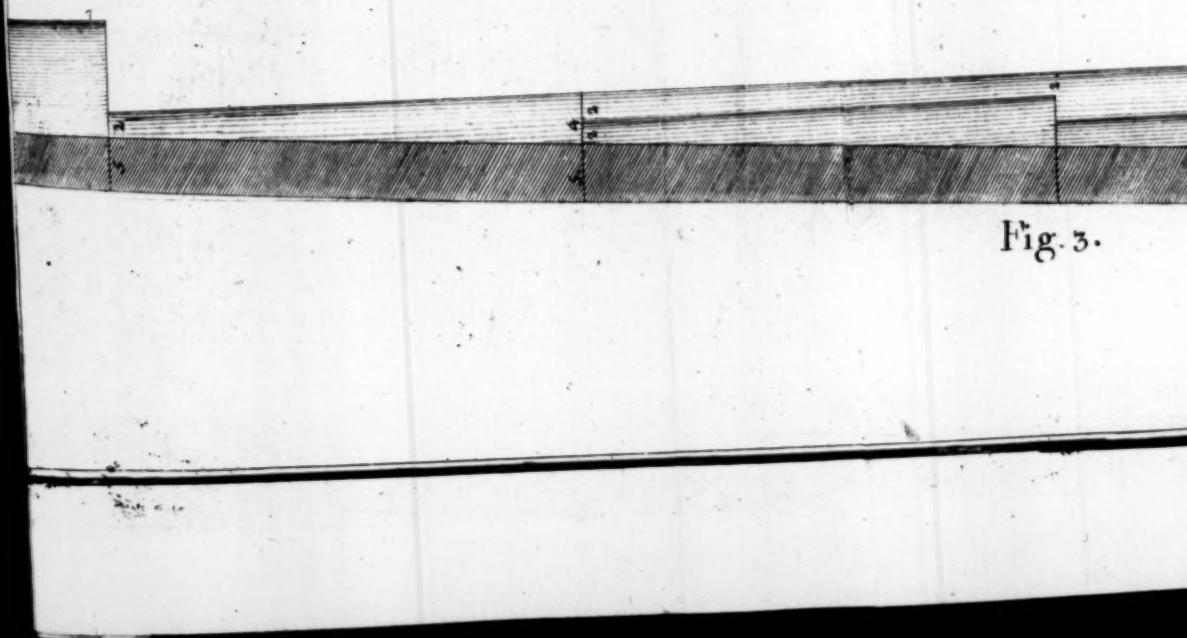


Fig. 3.

BY RIVERS

Plate 25.

Page

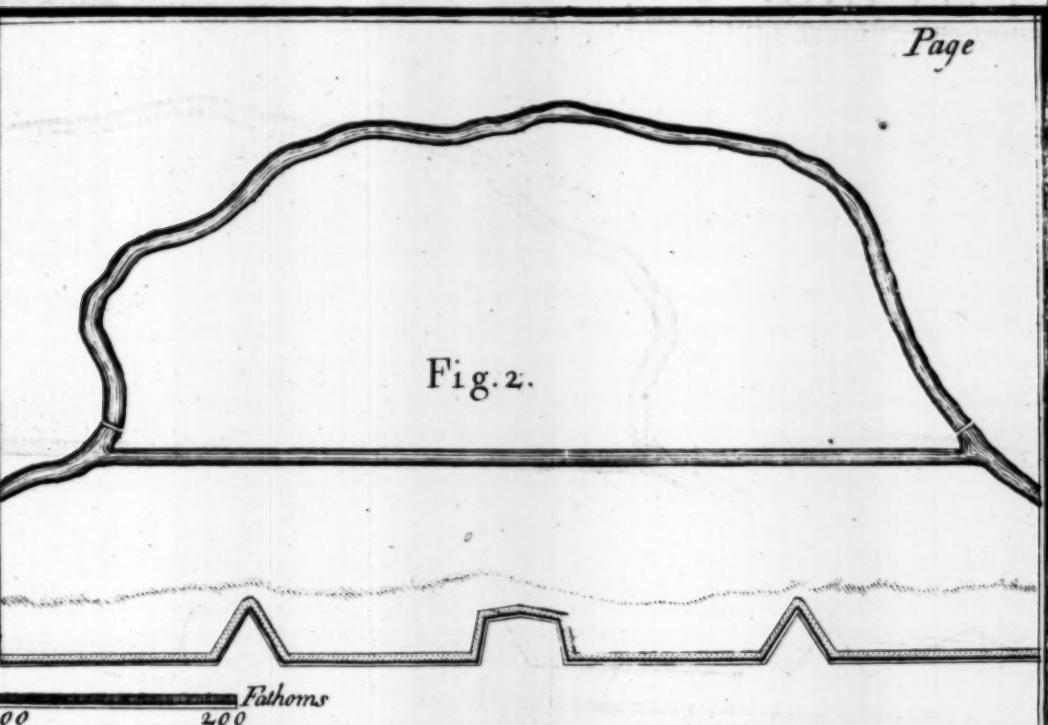
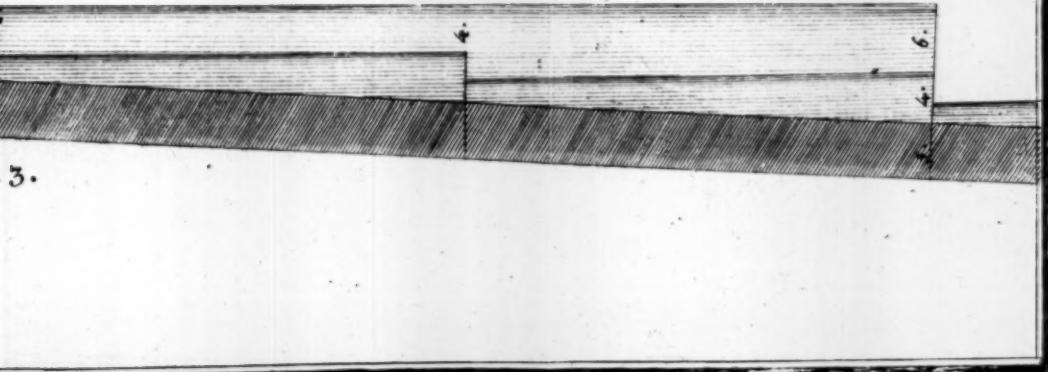


Fig. 2.

UICES

3.



HEADS OF DAM

Fig. 1.

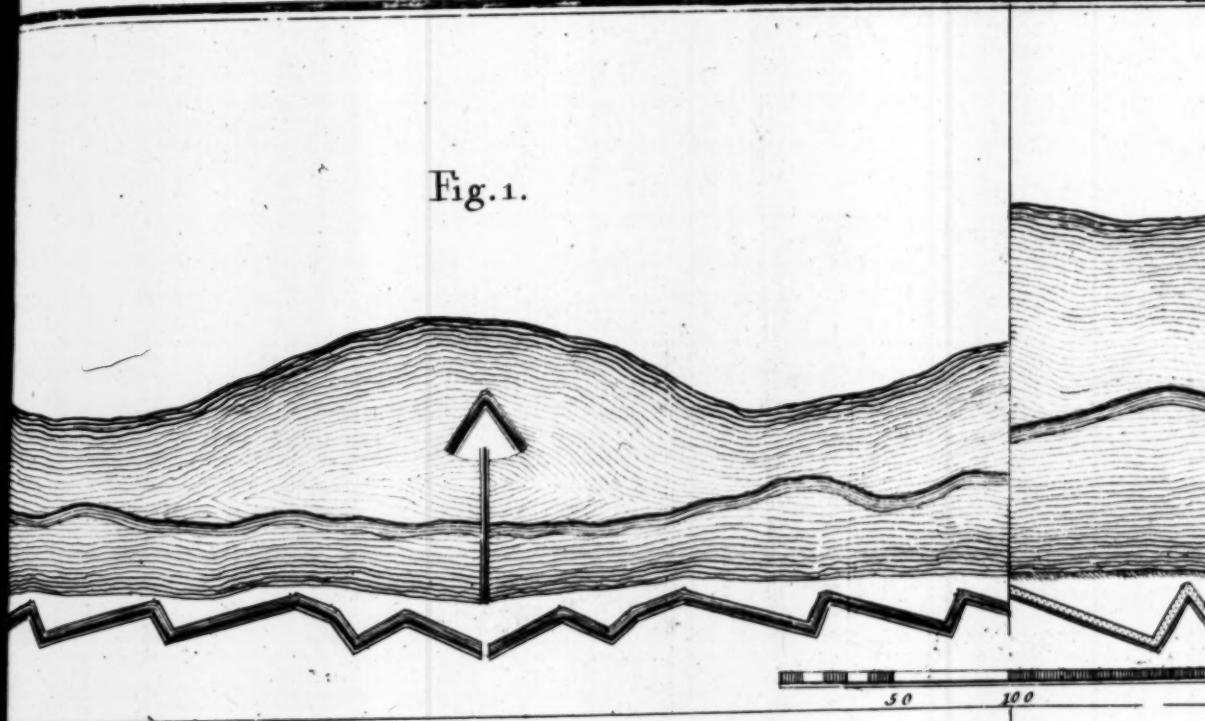
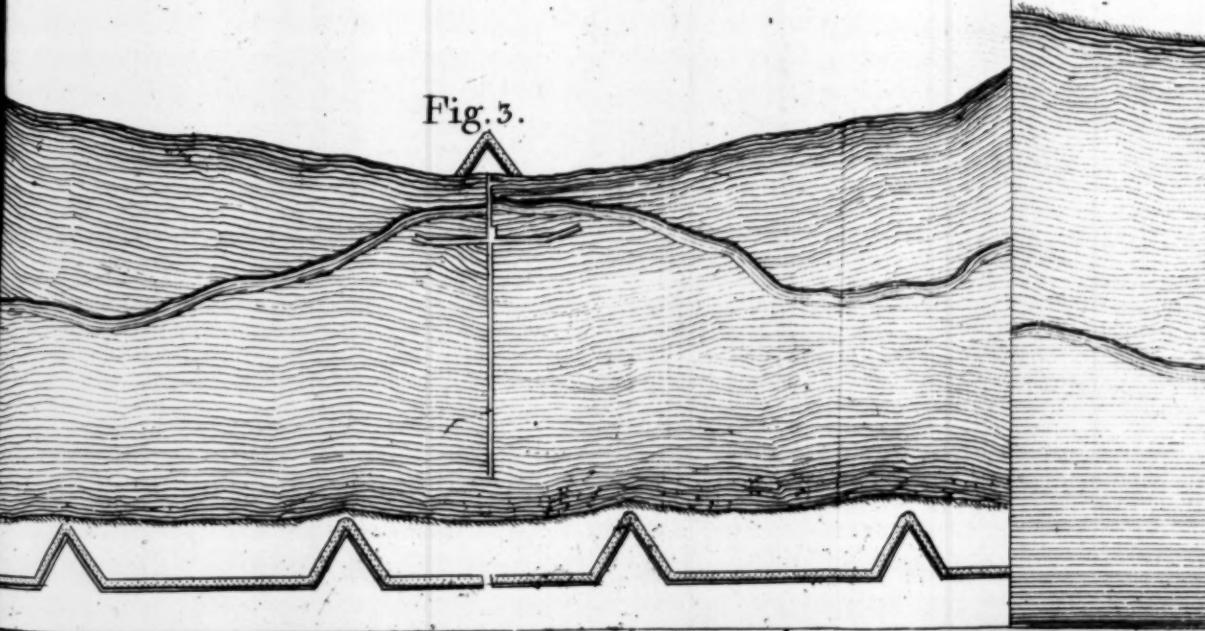


Fig. 3.



DAMMS

Plate 26

Page

Fig. 2.

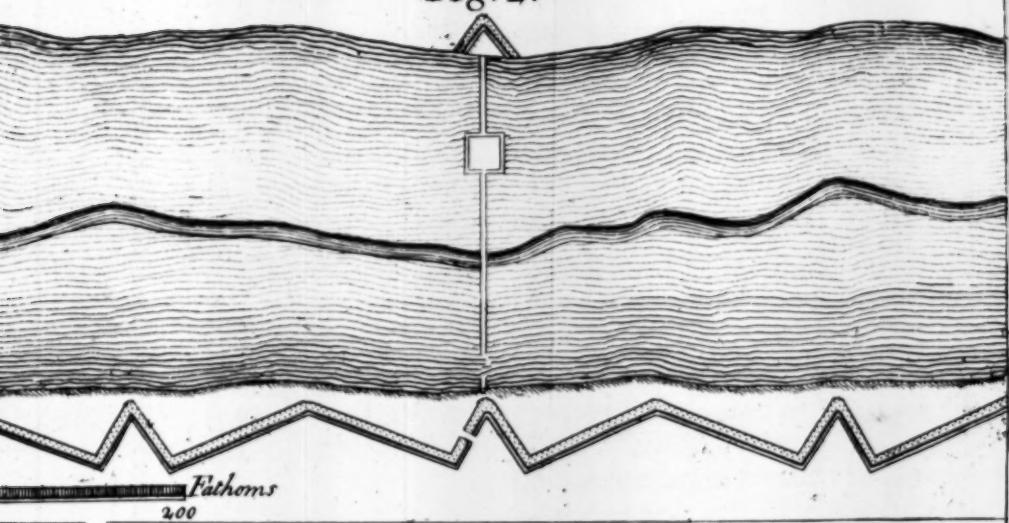
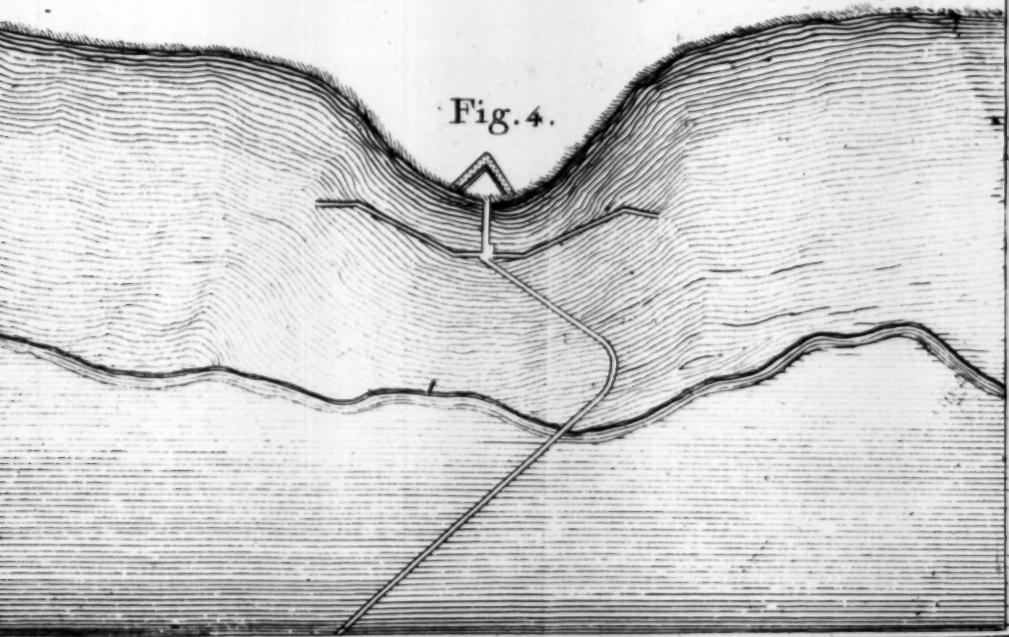
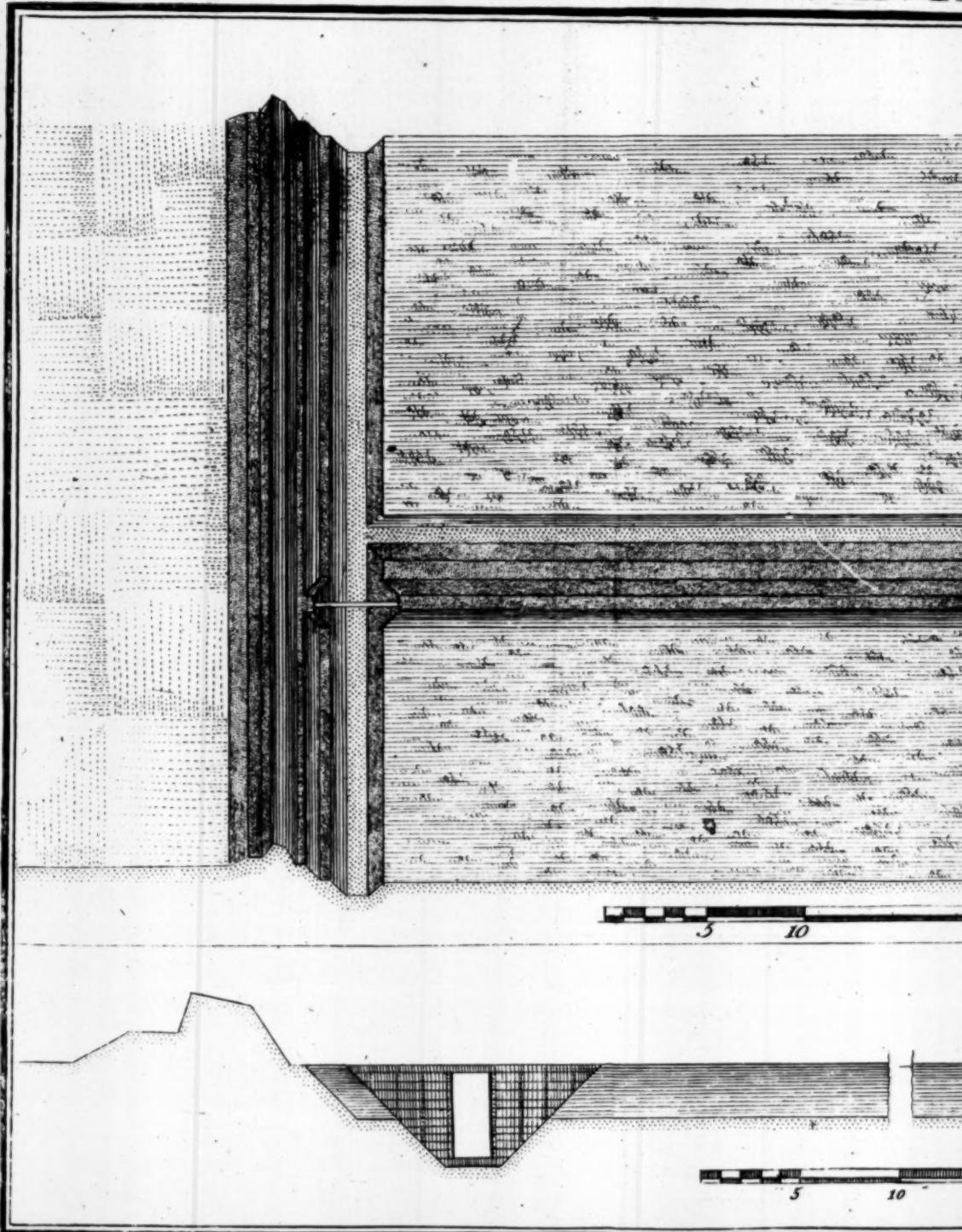


Fig. 4.



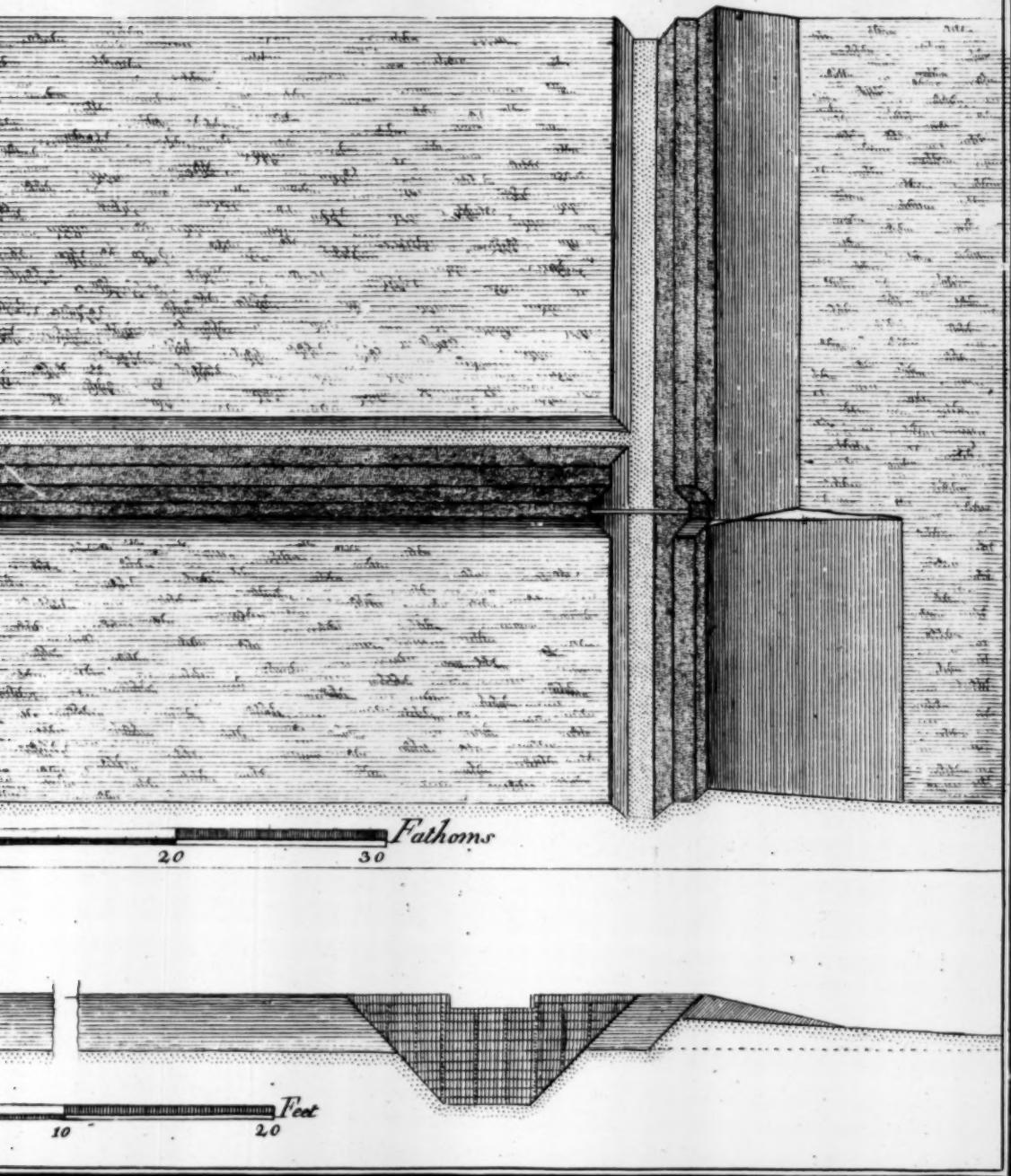
INUNDATIONS IN F



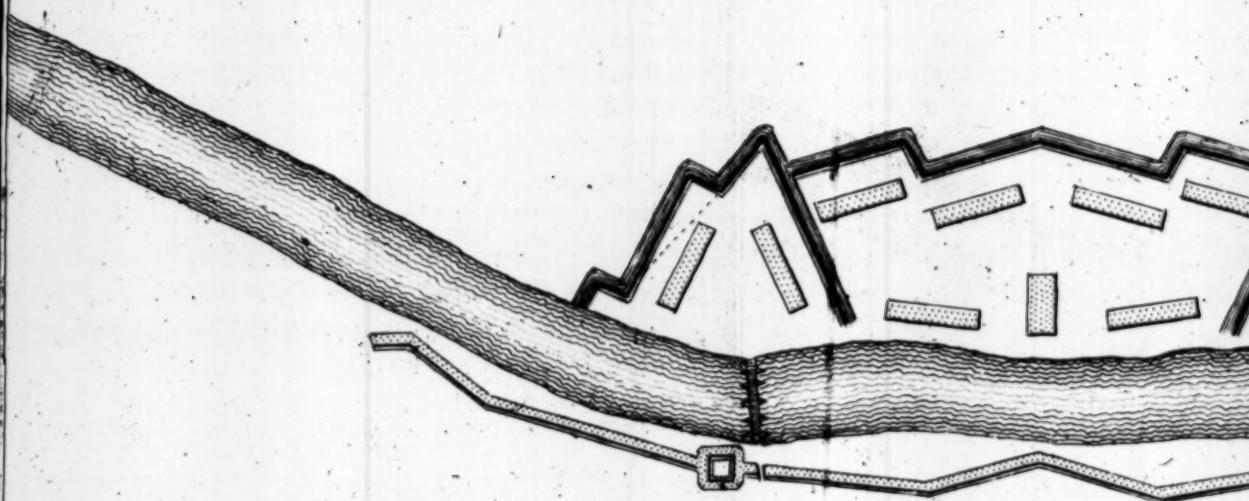
IN FLAT GROUND.

Plate 27.

Page



PASSAGES OF R

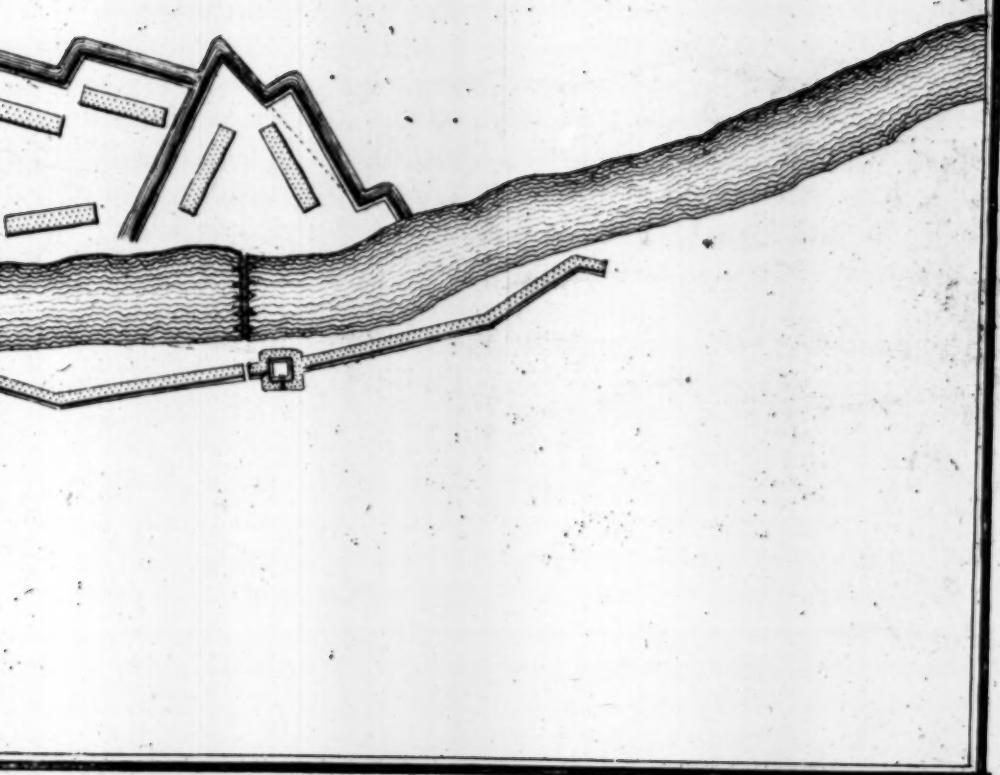


50 100 200 Fathoms

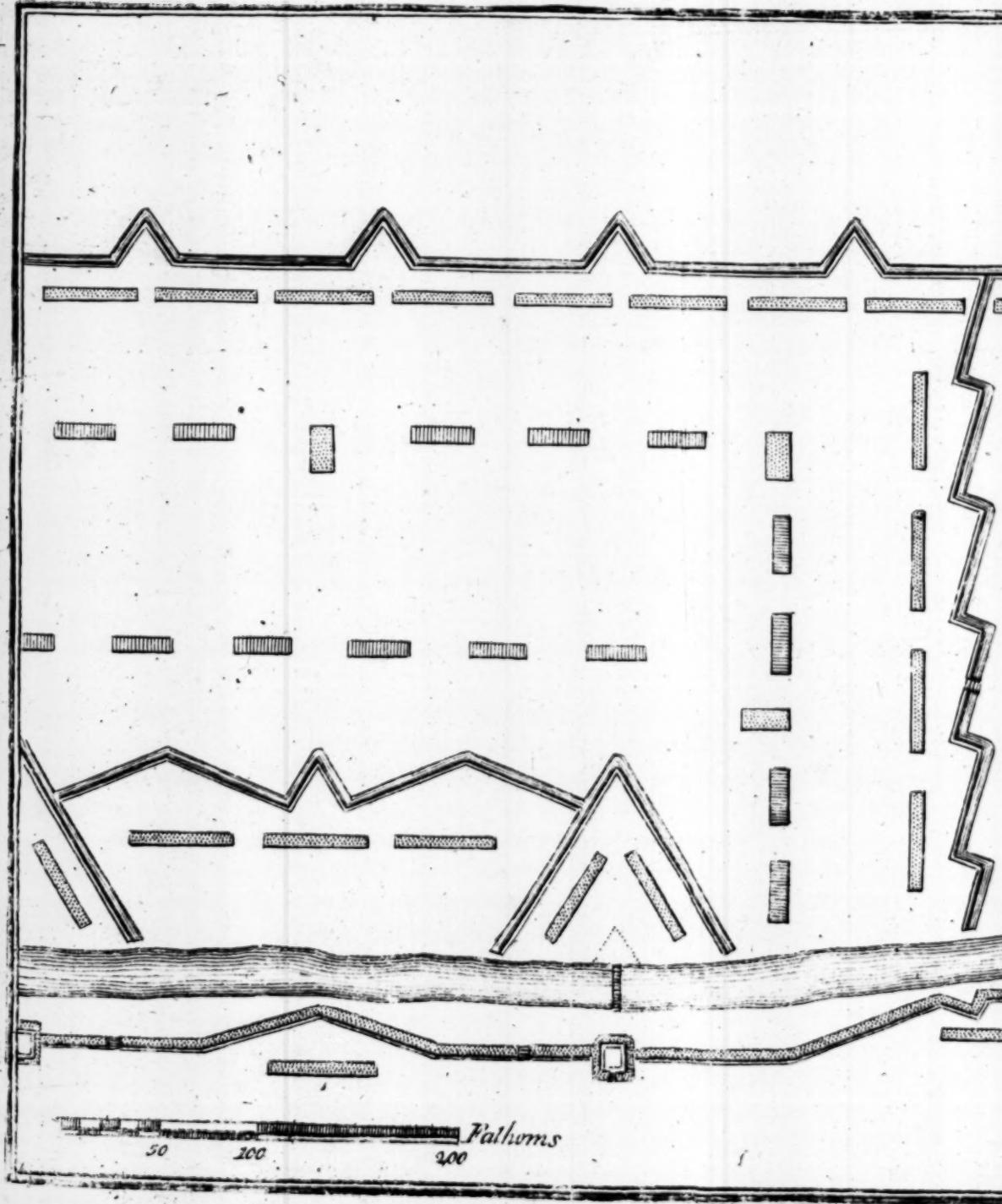
OF RIVERS

Plate 28

Page



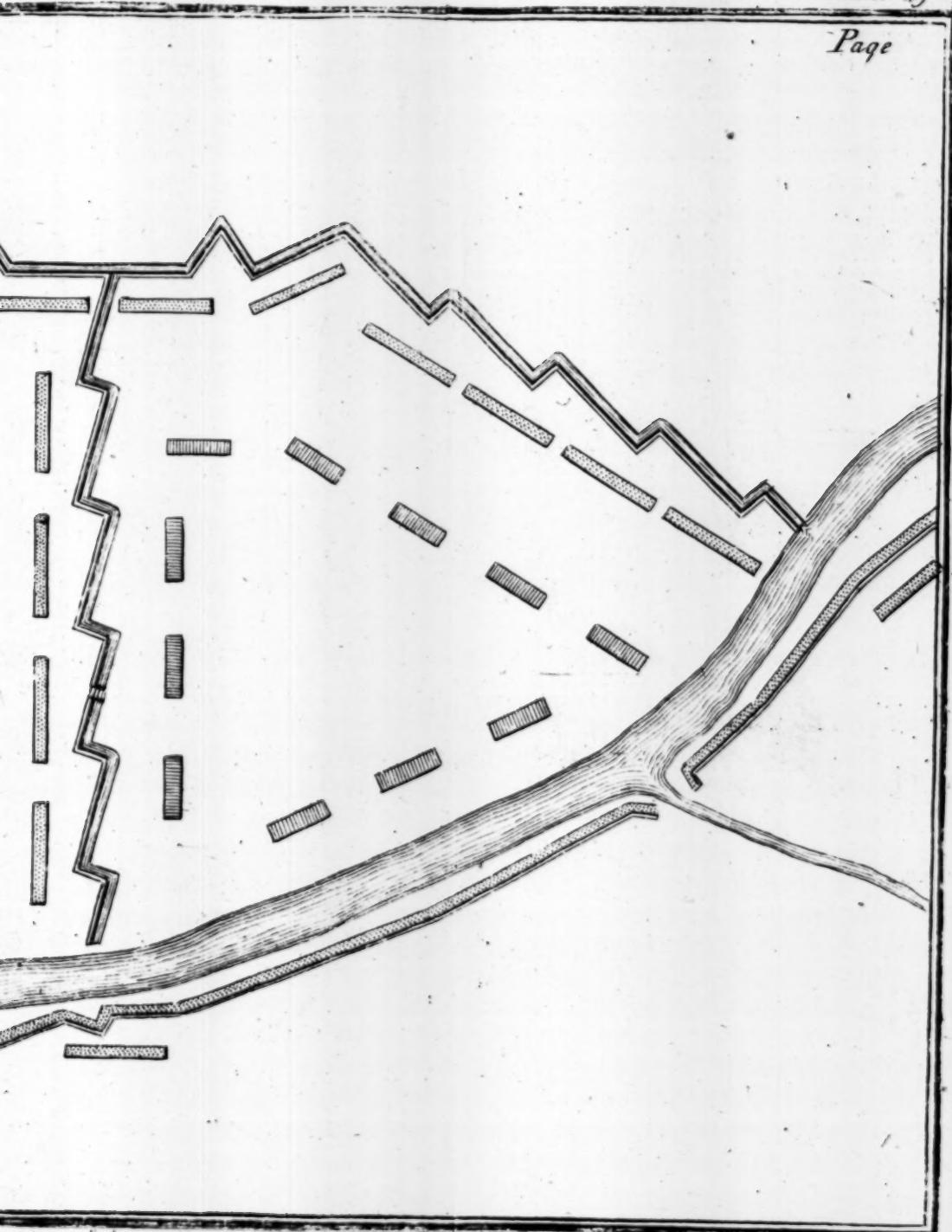
A RIVER TO BE F



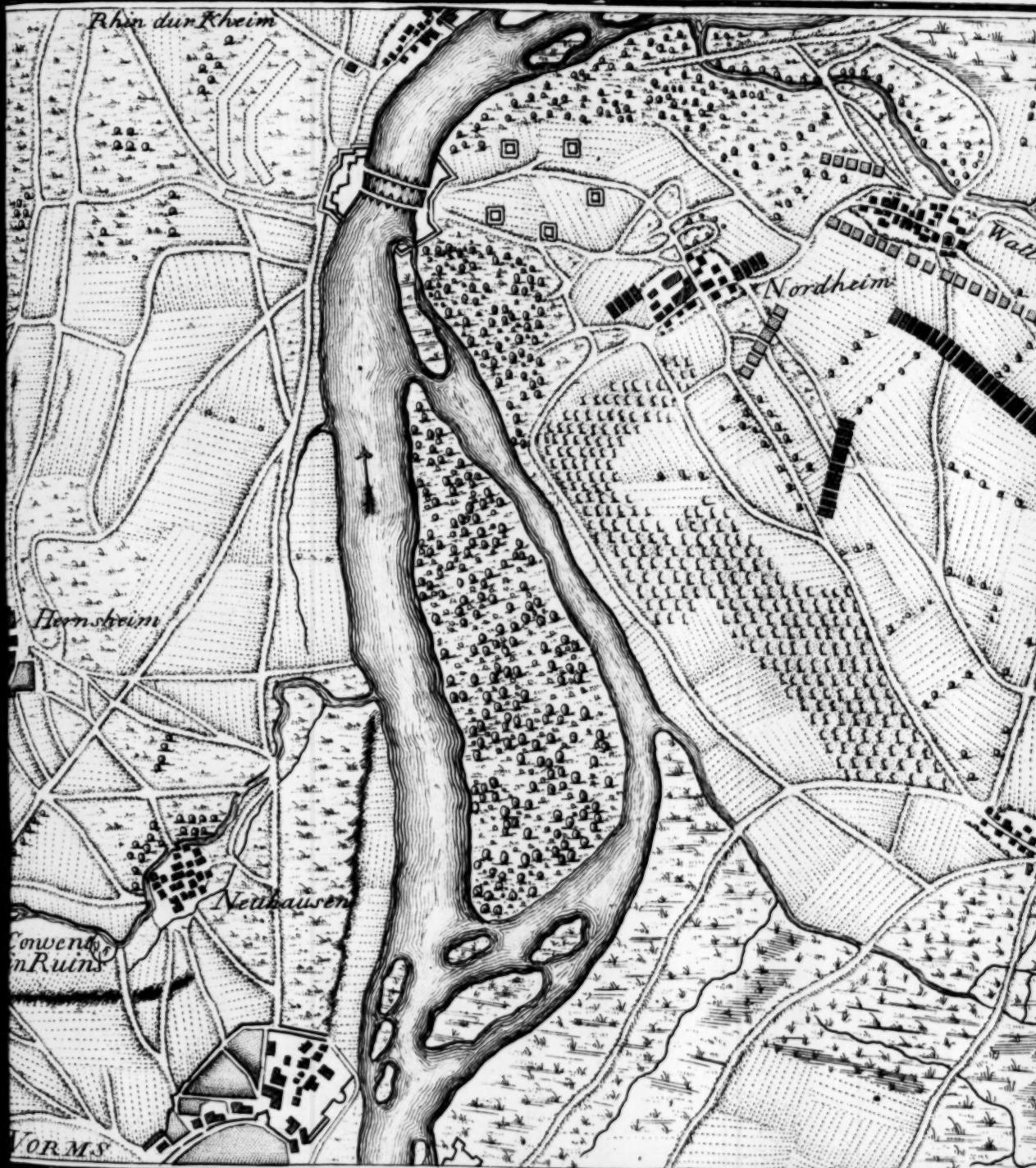
BE REPASSED

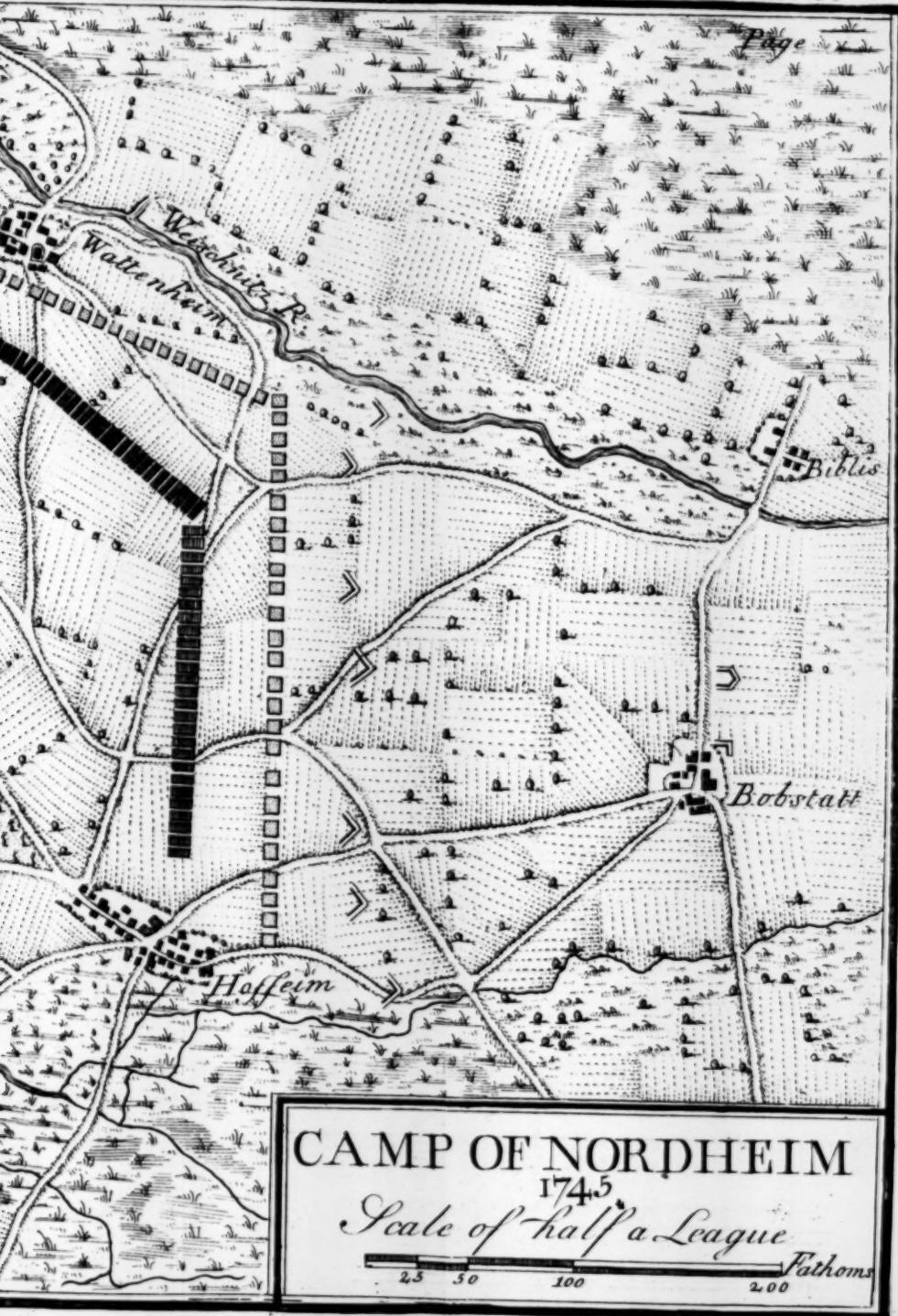
Plate 23

Page



EXAMPLE





TO OPPOSE THE PASSAGE OF



Fig. 1.

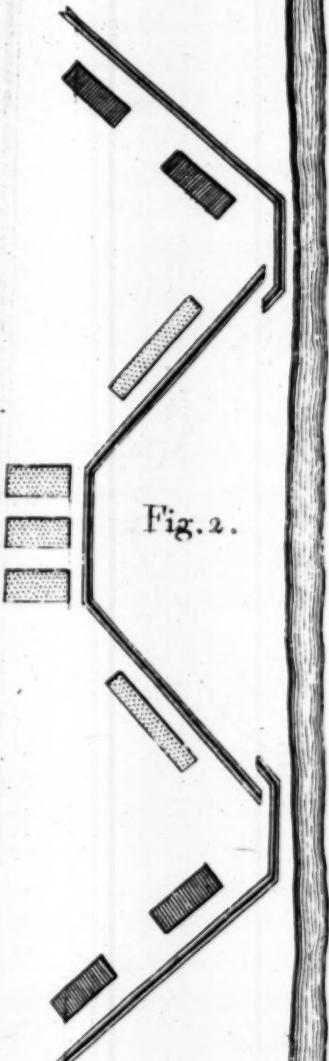


Fig. 2.

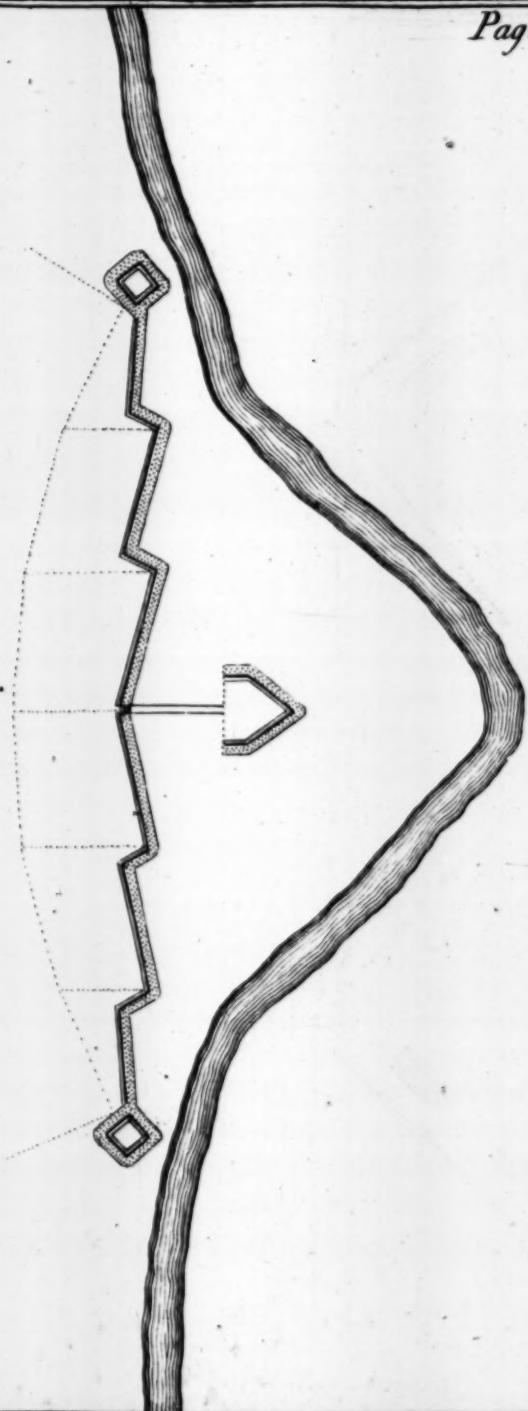
Path
50 100 200

AGE OF A RIVER

Plate 31

Page

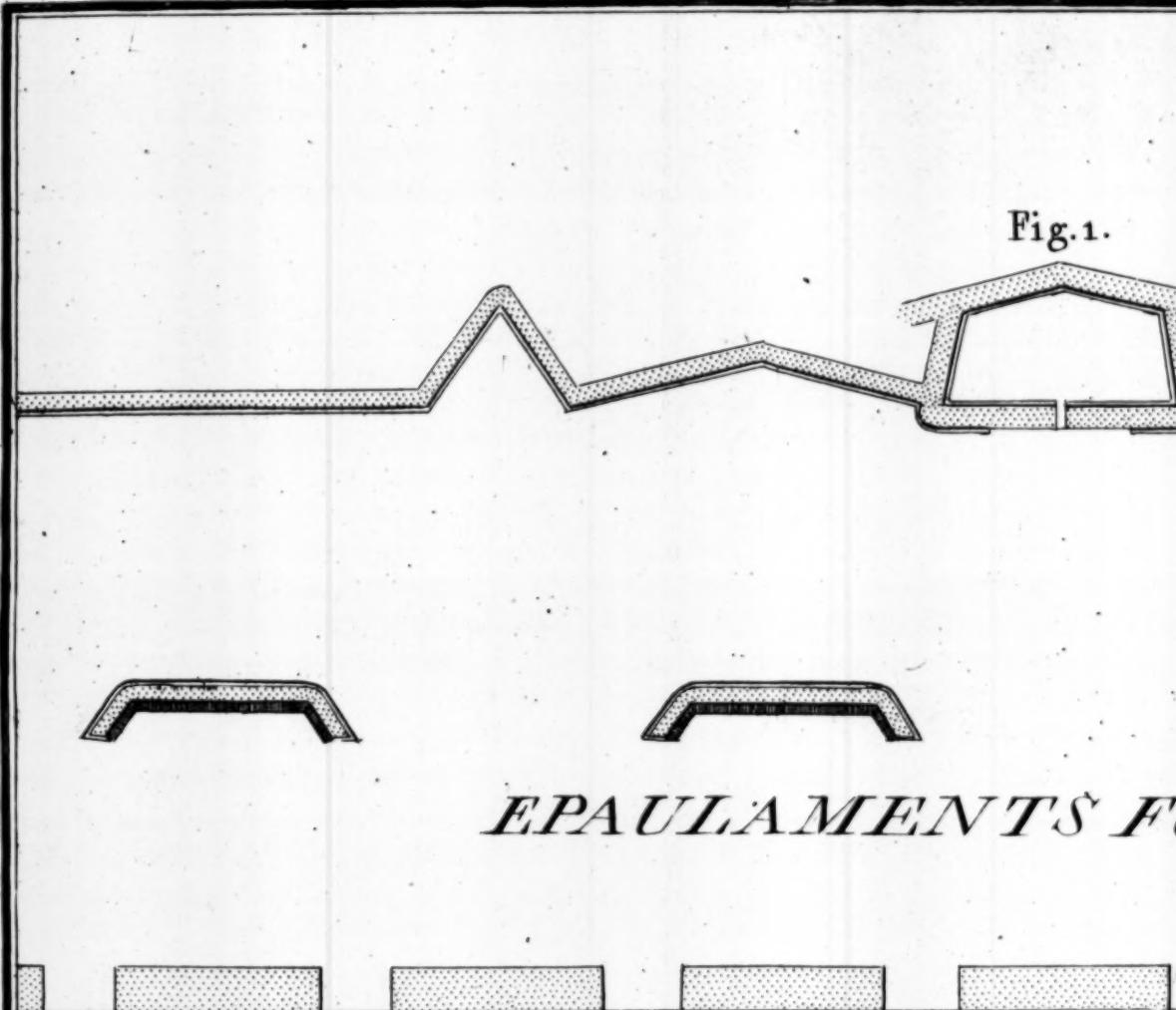
Fig. 5.



Yards
200

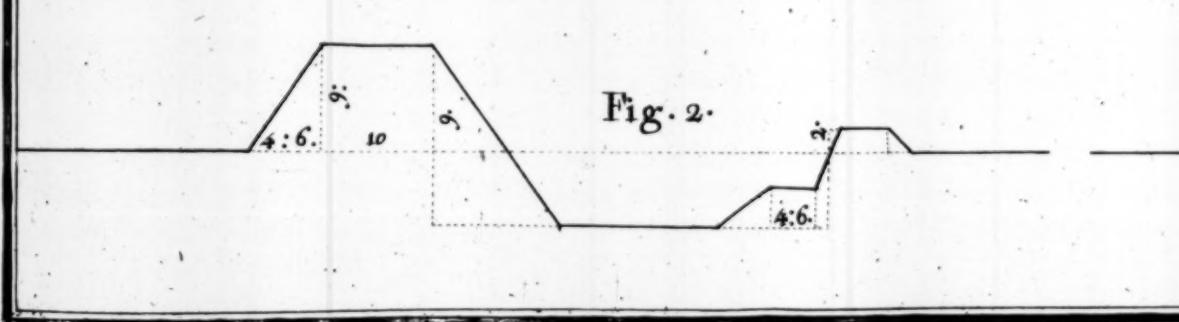
WORKS CLOSD AT THEIR

Fig. 1.



EPAULAMENTS F

Fig. 2.

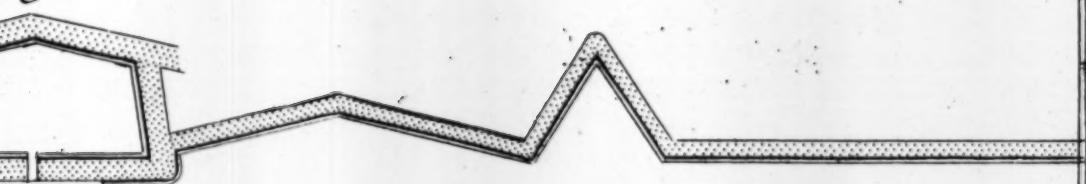


THEIR GORGE JOIN'D TO LINES

Plate 32.

Page

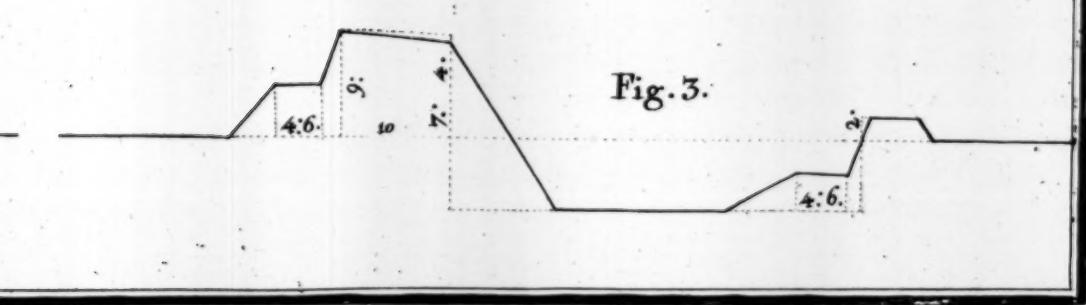
ig.1.



RS FOR CAVALRY



Fig. 3.



WORKS FOR THE GATES

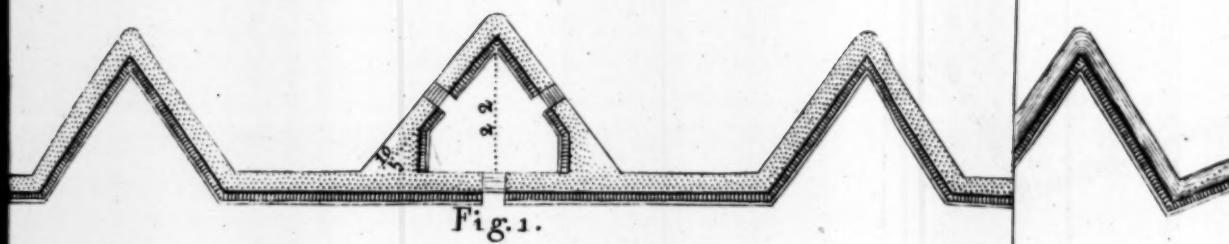


Fig. 1.

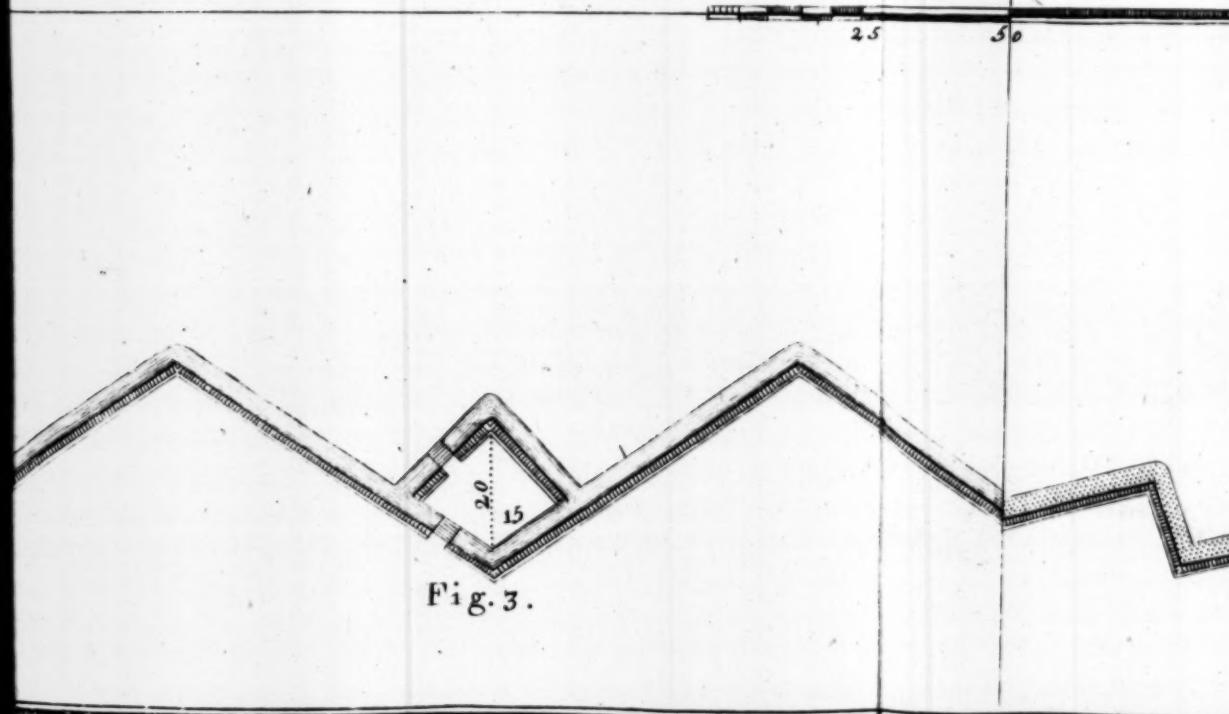


Fig. 3.

TES OF LINES

Plate 33

Page

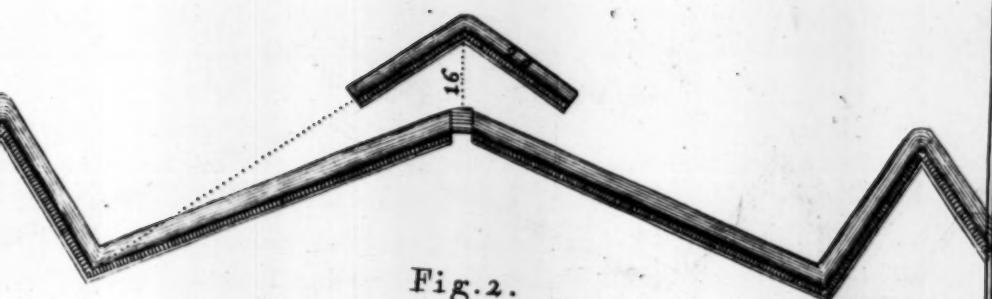


Fig. 2.

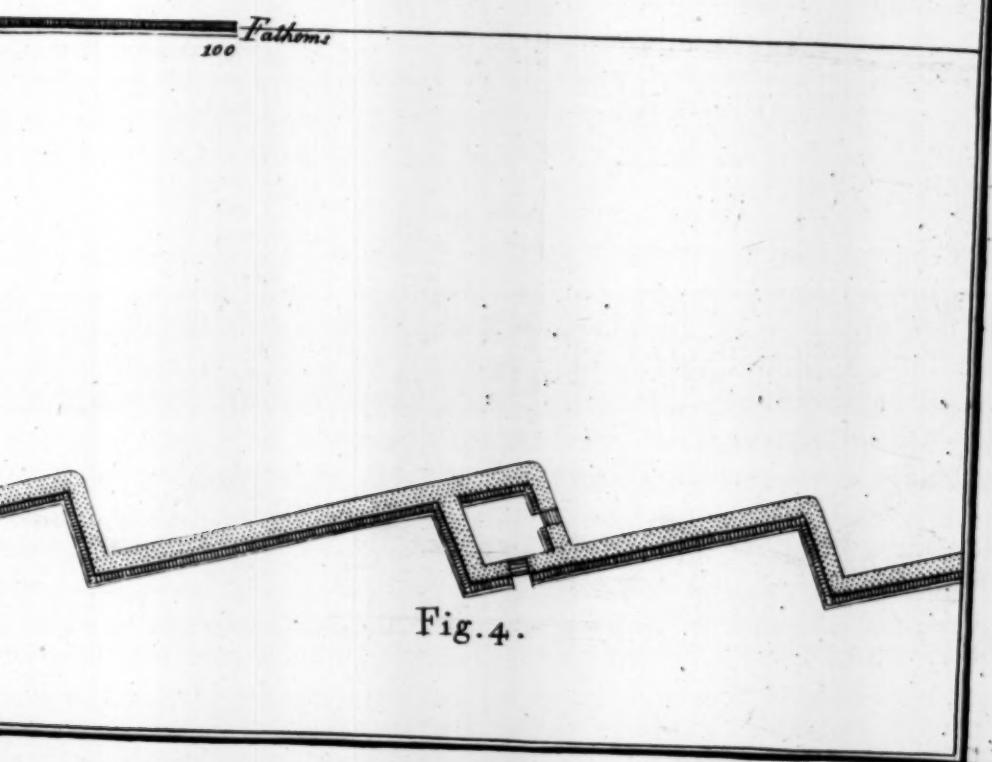


Fig. 4.

Fathoms
100

GATES OF BASTION^D E

Fig.1.

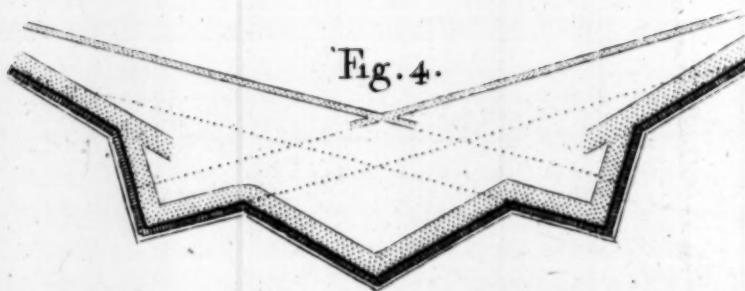


ADVANCD DITCHES

Fig.3.



Fig.4.



ND LINES

Plate 34

Page

TCHES

Fig. 2.

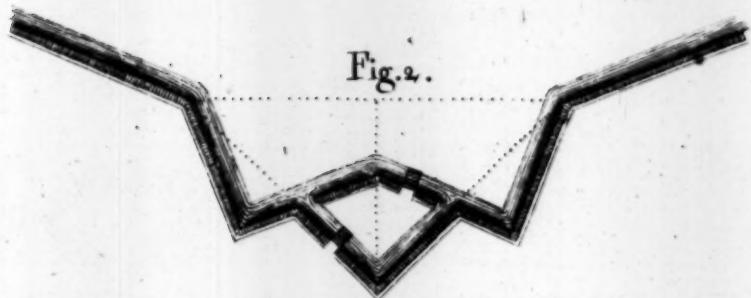
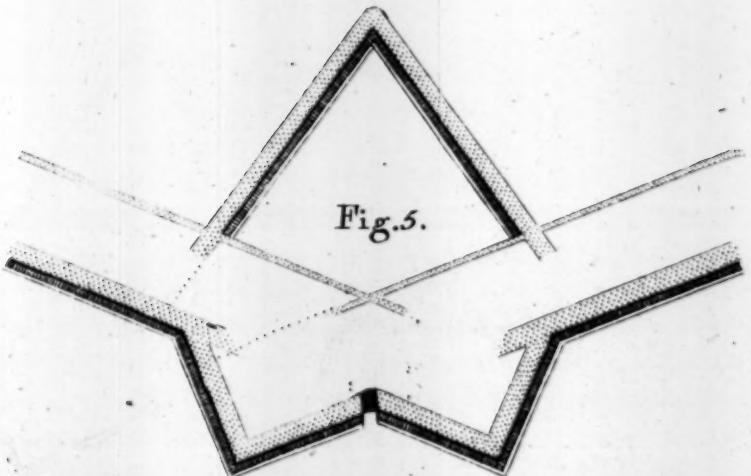
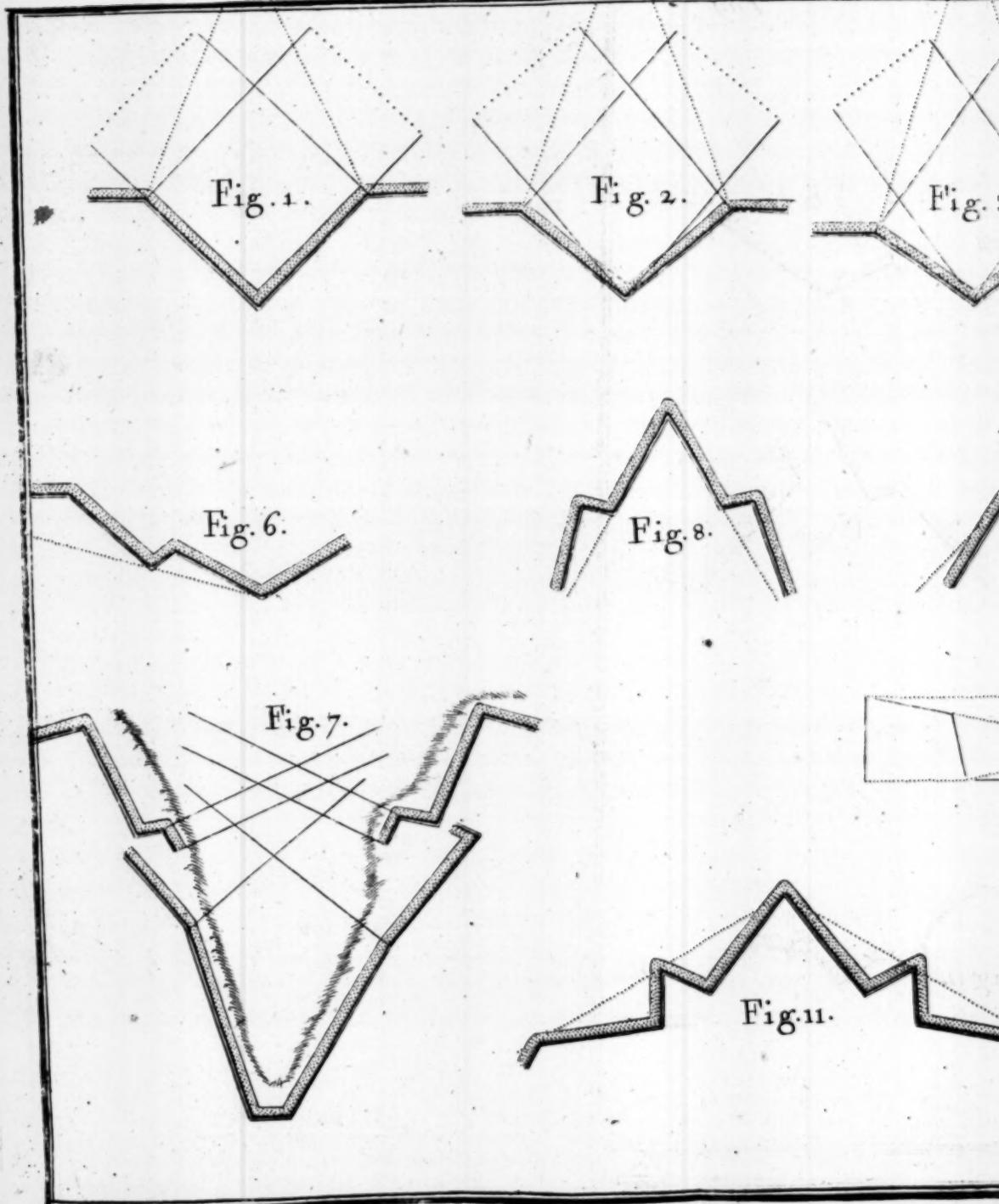


Fig. 5.



Fathoms
100

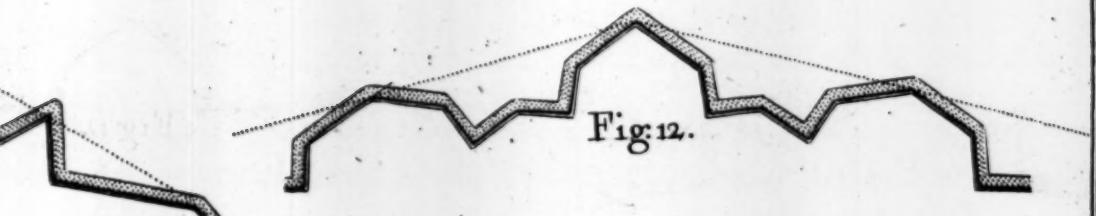
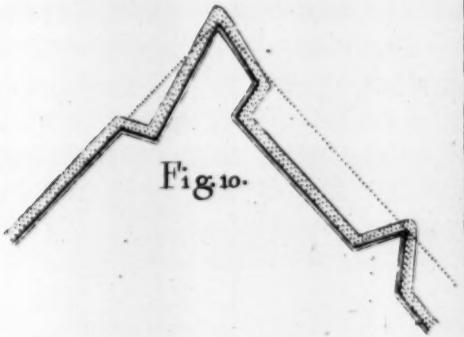
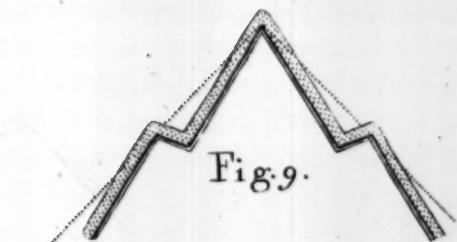
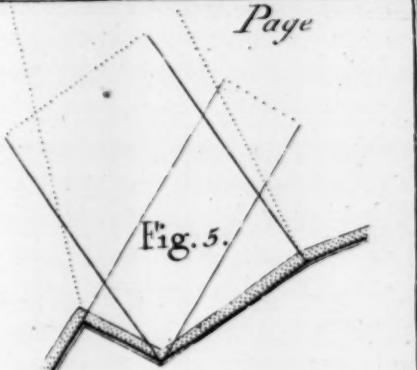
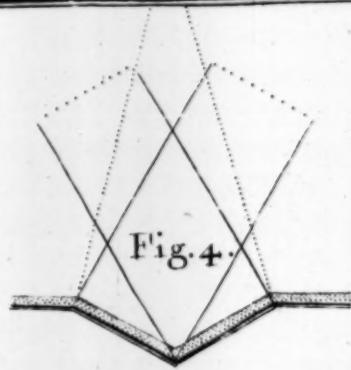
OF A N G L E



ANGLES

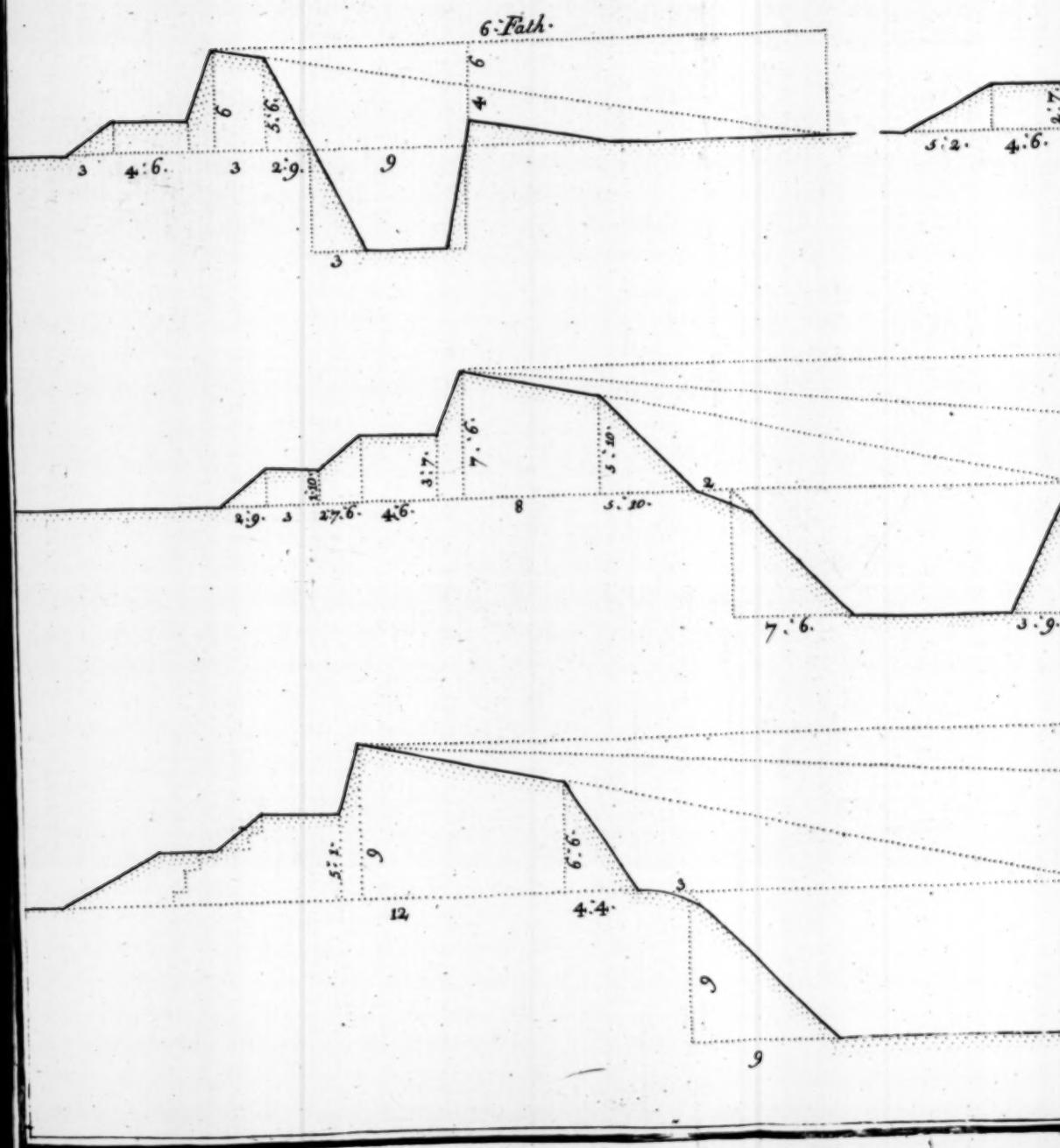
Plate 35.

Page



50 100 200 Fath.

PROFILES

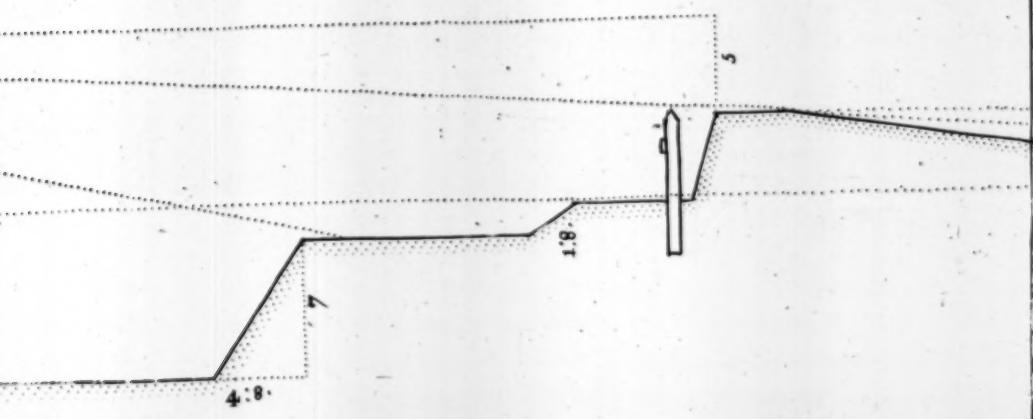
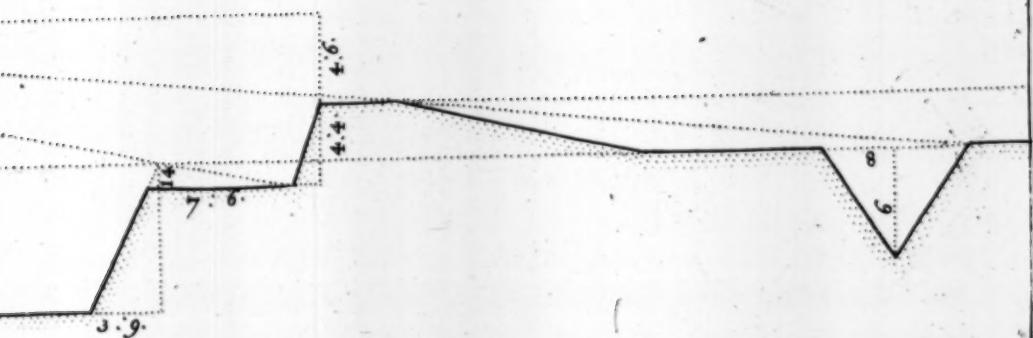
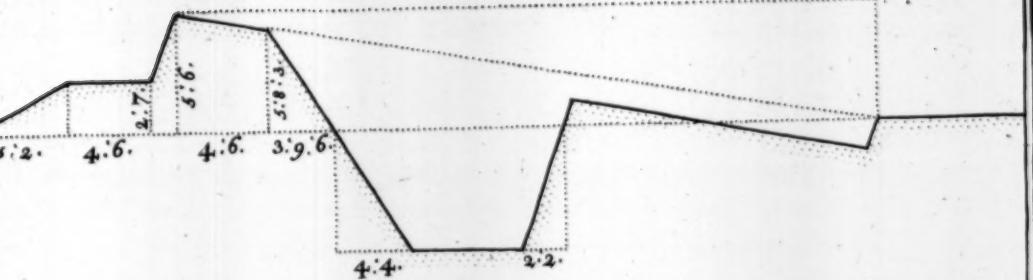


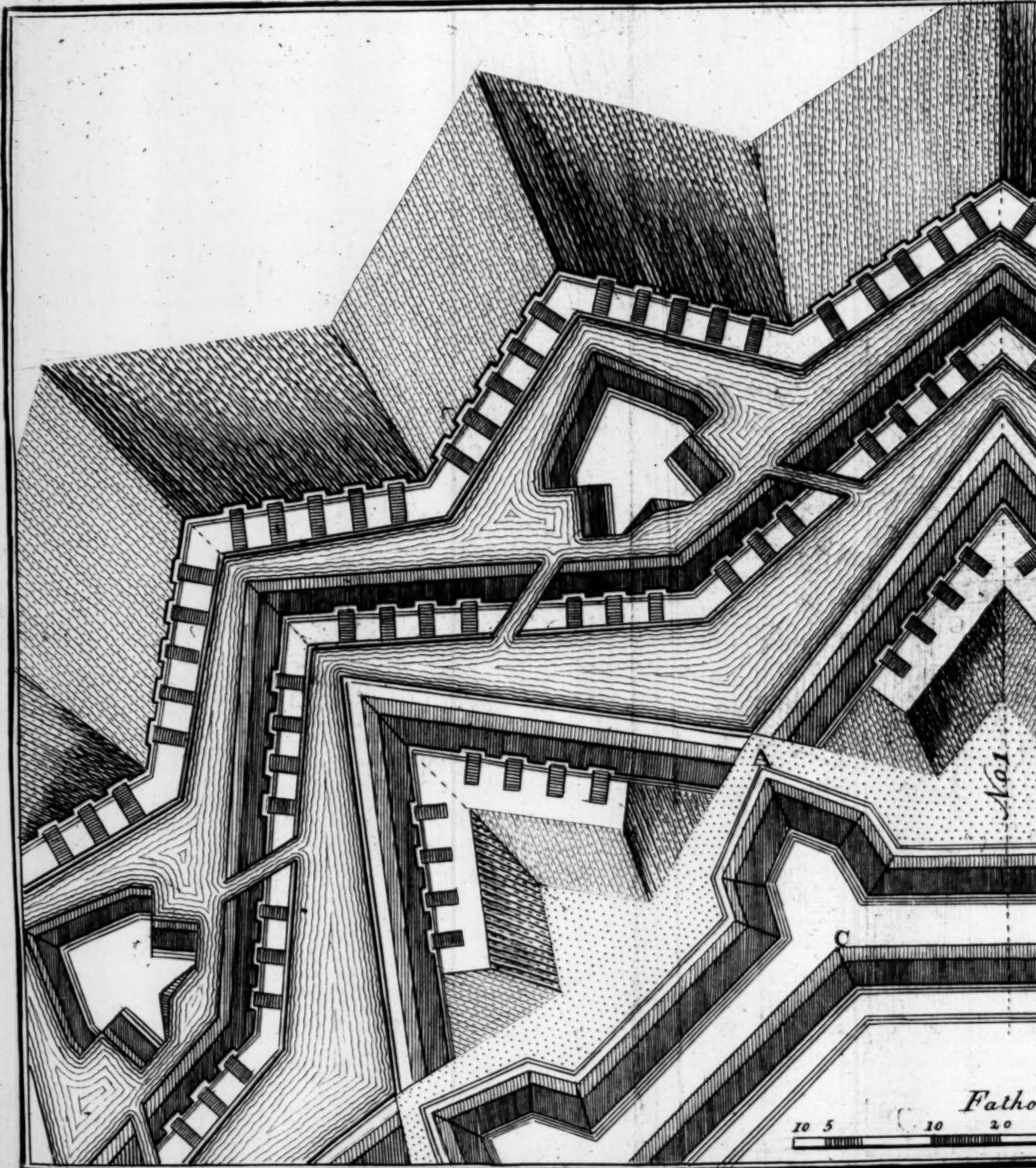
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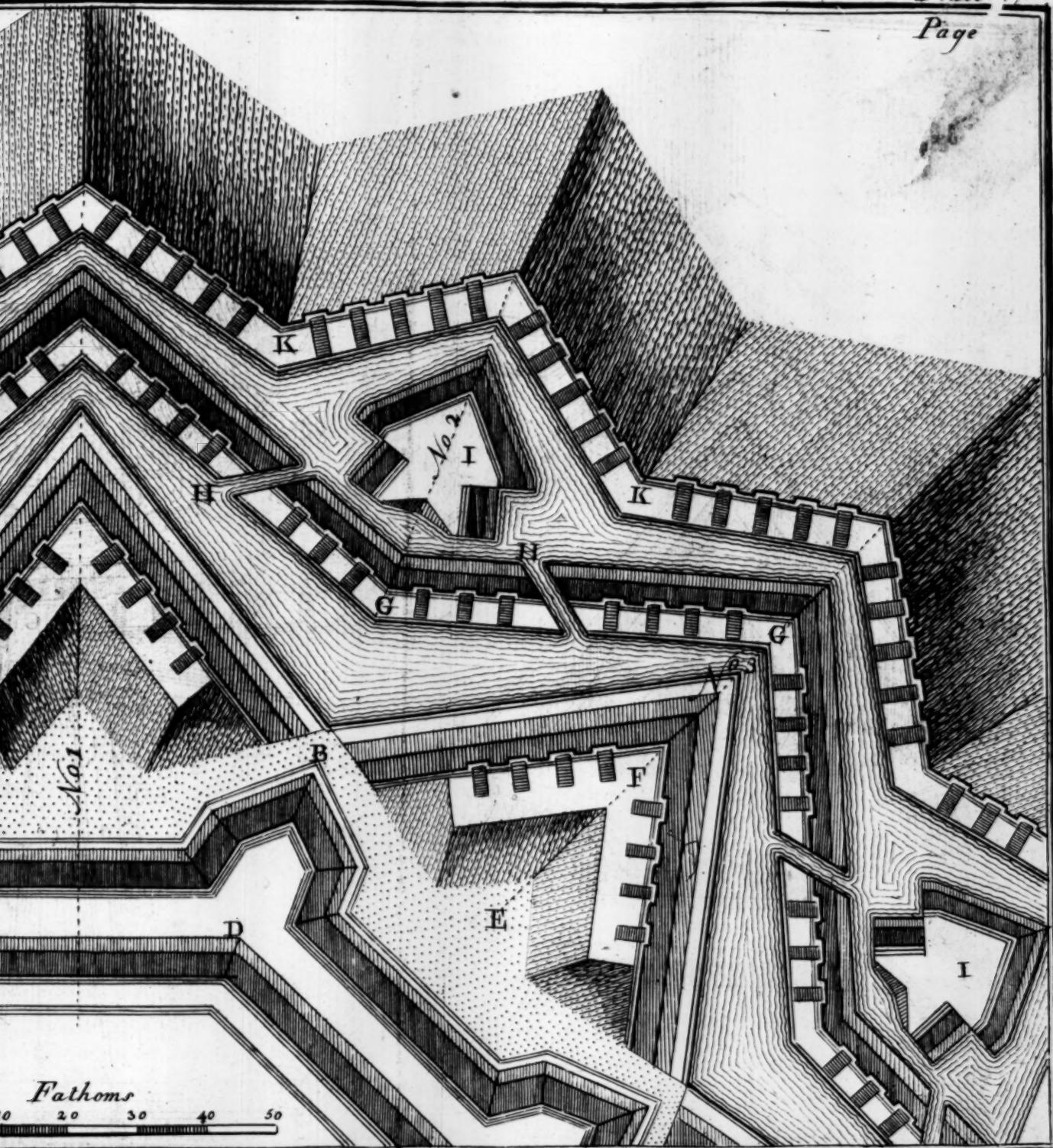
Plate 36

Page

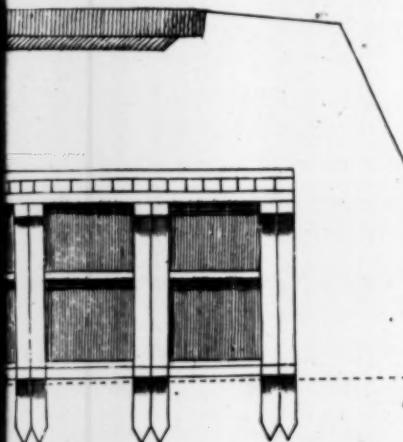
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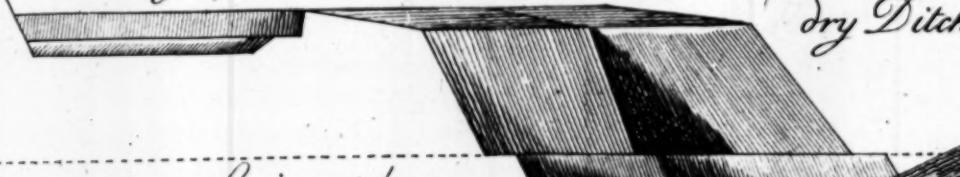




Cavalier

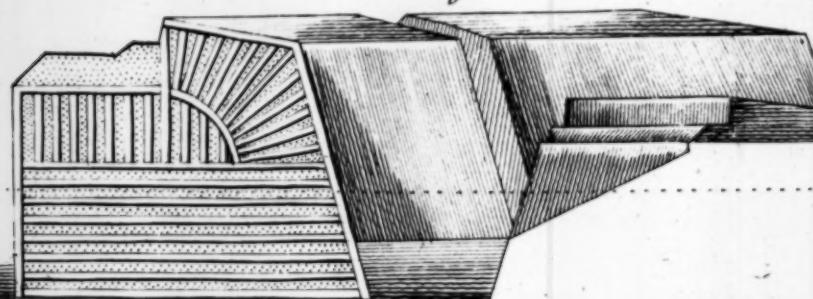


Body of the Place



N.^o 1

Counterguard

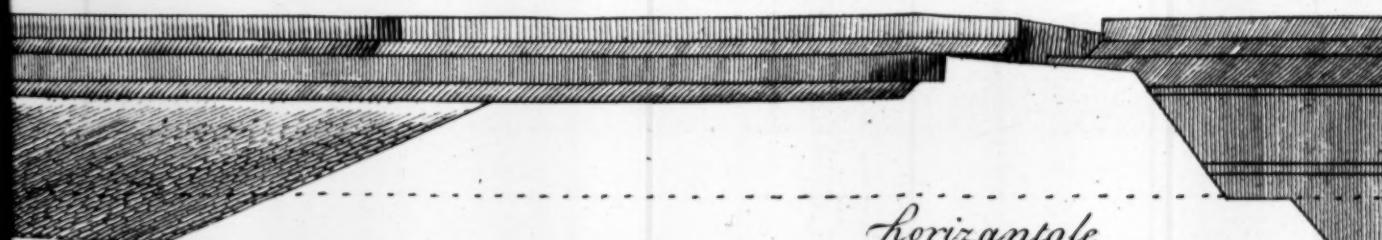


Lunette

horizontol

N.^o 2

Ravelin



horizontole

N.^o 3.

Count

10 9 8 7 6 5 4 3 2 1

10

N.^o. 1.

Dry Ditch

Ravelin

Line

N.^o. 2.

Covert way

Line

ntol

N.^o. 3.

Counterguard

Covert way

Line

10

20

30

Fathoms